















# PLANT PROPAGATION



The Fully Illustrated Plant-by-Plant Manual of Practical Techniques



















#### AMERICAN HORTICULTURAL SOCIETY

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# How to use this book

This book opens with a general introduction to plant propagation, explaining how practical techniques were, and continue to be, developed; how they relate to natural ways of plant reproduction; the influence of the climate and the propagation environment; how to use appropriate tools, equipment, and growing media; and common problems affecting propagated material.

The chapters that follow explain practical techniques and are arranged according to plant type: these adhere to botanical classification, so that each chapter discusses only true members of the type. For example, short-lived perennial plants grown as annuals may be found in the Perennials chapter. Woody climbing plants are included with shrubs, to which they are closely associated. Other climbers may be bulbous, annuals, or succulents and are discussed in relevant chapters. Fruits also fall into various plant groups, such as perennials, shrubs, and trees. The Bulbous Plants chapter covers corms, bulbs, and tubers; few rhizomes are true storage organs, so rhizomatous plants appear in the Perennials chapter.

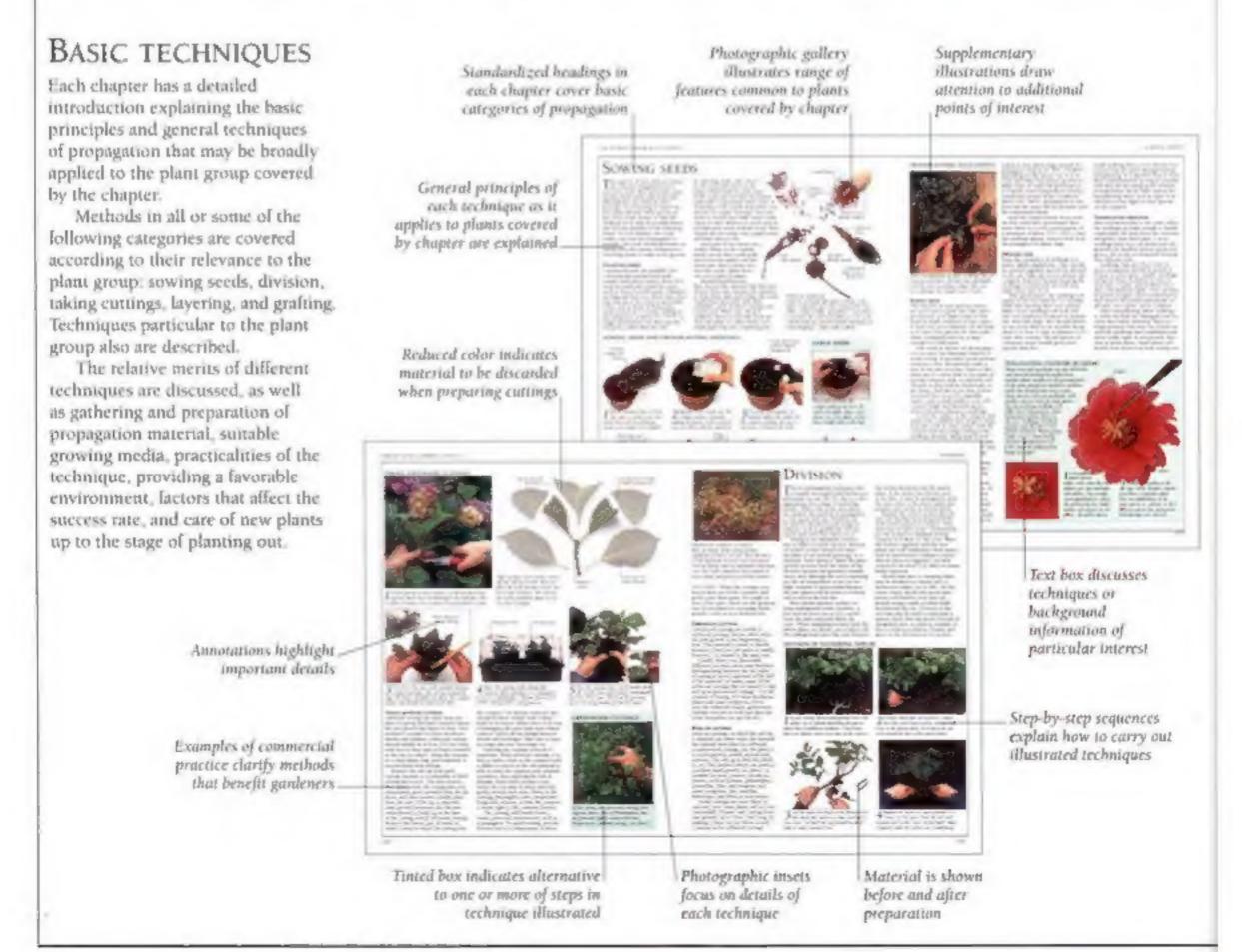
Alpine and water garden plants are artificial groupings based on their cultivation; since most such plants are perennials, they are featured in the Perennials chapter. Culinary herbs are included in the Vegetables chapter; other herbs are described where relevant.

Each practical chapter begins with basic techniques specific to the plant type in question and then details the finer points of propagation of many genera, plant by plant. Features on special-interest plants also appear in these chapters. Some popular genera with diverse habits (for example, some species may be trees, others shrubs) may have entries in more than one chapter.

#### PROPAGATION TECHNIQUE RATINGS

The rating system in the plant-by-plant A–Z dictionaries provides the reader with a quick reference to the relative ease or difficulty of each method of propagation that is listed for any particular genus. The ratings are as follows:

Leasy II moderate III challenging

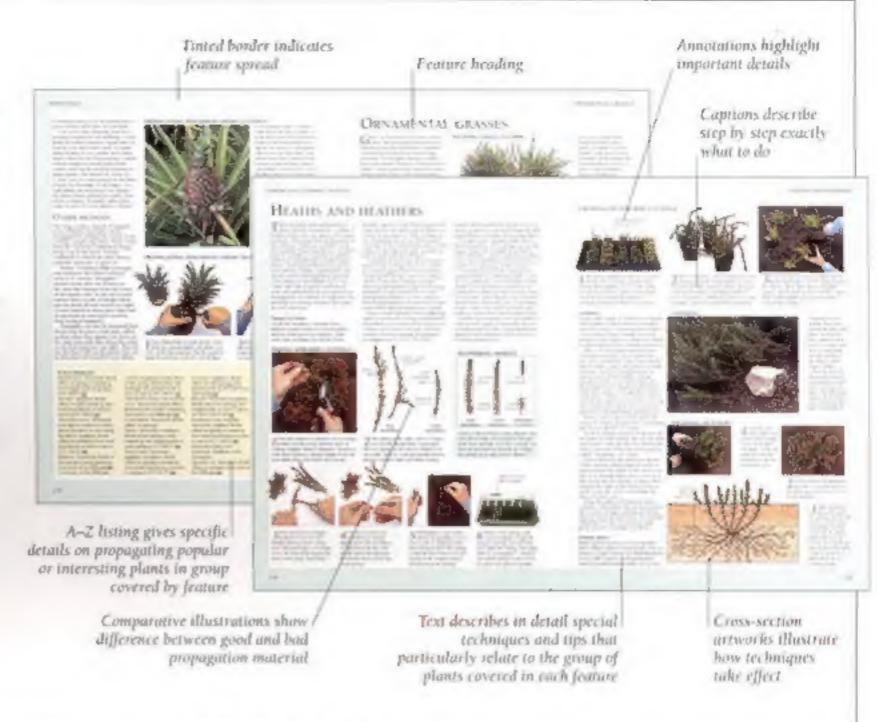


#### **FEATURES**

Most chapters contain features on popular and botanically interesting plant groups. These are palms and cycads, conifers, heaths and heathers, roses, ferns, alpine plants, water garden plants, bromeliads, ornamental grasses, orchids, and culinary herbs.

Each feature focuses on modes of propagation that are peculiar to the featured plants, describing their characteristic ways of reproduction and how these are exploited in various techniques. The techniques are fully illustrated with step-by-step photographs and explanatory artworks. The plants' special needs are discussed, with tips on how to achieve success.

Further details of individual plants are given in A-Z listings in most features. Individual entries for conifers and alpine plants, both large and varied groups, are included in the main A-Z dictionaries of their chapters.





relevant to individual

genus or species

basic technique and including special (ips

on the genus or species within it

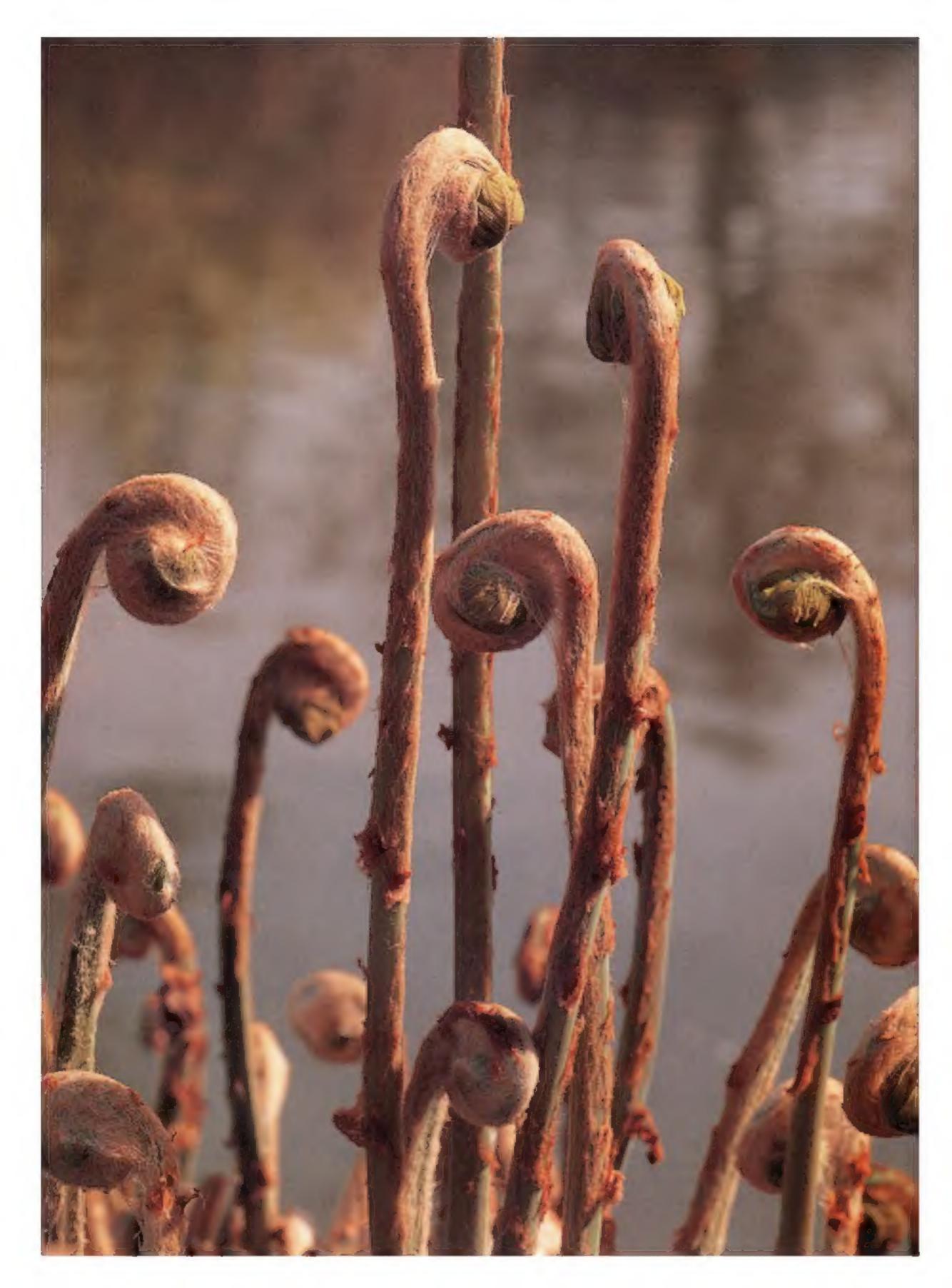
#### A-Z DICTIONARIES

Practical chapters each include a plant-by-plant dictionary arranged alphabetically by botanical names and describing a range of genera in the plant group. These include genera that are commonly grown in various climates, are propagated in ususual ways, or need special care.

Entries are of varying lengths for different genera, according to the number and complexity of ways in which each is propagated. At the top of each entry, possible methods, when they may be undertaken, and eastness ratings are summarized for easy reference. Within each entry, guidance is given on the merits of each method covered to enable the reader to choose the most suitable. Where needed, individual species, hybrids, or cultivars are discussed.

Special methods not covered in the chapter's basic techniques are fully explained and illustrated in relevant entries. Cross-references are given to basic techniques or similar genera. Each spread also lists many additional genera, with concise details on how they are increased.

Listing gives concise details on propagating other genera





# INTRODUCTION

An understanding of the ways in which plants grow and reproduce, and of the relevance and application of practical techniques, will allow the gardener to propagate plants with ease and confidence

The art of propagation is as old as civilization: from the beginning, farmers and gardeners have observed, learned, and adapted from nature to perfect ways of increasing plants in cultivation. The parallels between plant reproduction in the wild and long-established methods of propagation are here described, as well as the advances made with the help of modern technology that may influence the way we garden in the future.

The practice of propagation is always easier if based on a thorough understanding of how plants function. The mechanisms of both sexual reproduction (from seeds) and asexual or vegetative reproduction (such as layering) are explained and illustrated in detail to show how the techniques of propagation are applied, in what ways they improve on natural methods, and why they are successful.

The practicalities of propagation are also dealt with: suitable tools for the various tasks are illustrated, together with the range of containers that are used in propagation. The importance of the growing medium is recognized, with a survey of the types of ingredients, soil mixes, and other media that may be used, and their relative merits. Advice is also given on how to make suitable soil mixes at home.

#### REGAL FERN

The magnificent royal fern, Osmunda regalis, may be raised from spores or propagated vegetatively. Spores must be sown quickly because they become nonviable after three days. Mature plants form clumps that may be divided.

Climate has a great influence on propagation, how it is done, what plants may be increased, and the likelihood of success. For instance, in colder climates, much propagation is carried out under cover, perhaps with artificial heat, whereas in warm or tropical regions, plants are easily raised in the open garden. The main types of climates and the consequent differences in propagation are summarized, with a full-color map.

Success in propagation usually depends on providing a supportive environment for the plant material and, later, for the new plants. Their special needs – and ways of supplying them, whether in the home, the open garden, or in a greenhouse – are discussed and amply illustrated.



## LEARNING FROM NATURE

Plants have evolved a fascinating array of reproductive strategies in order to survive and increase and to colonize new ground. They have adapted to a wide range of adverse habitals, such as deserts (see below), high altitudes where winds damage foliage and discourage pollinating insects, and even water, where problems are completely different

Since the dawn of civilization, the farmer and gardener have used their observations of plant reproduction in the wild to develop propagation methods in cultivation. All plant reproduction is by seeds (sexual reproduction) or by vegetative (asexual) methods.

#### REPRODUCTION FROM SEEDS

Sexual reproduction remains the most important method of increase for many plants (see pp 16–21). Genetic material from a male and female parent of one species (preferably on different plants) unites in the seed or spore. The seed embryo forms a new plant that often looks the same as the parents but has a different genetic makeup to either

This capacity for evolution enables plants to adapt over a period of time to environmental changes or to colonize areas originally hostile to the species Another advantage of producing seeds



A SAFETY IN NUMBERS Echsum wildpreto colonizes the stony, dry hills of the Canari Islands by producing huge quantities of seeds

► DESERT DENIZEN Welwitschia mirabilis survives in the harsh deserts of southwestern Africa by collecting dew on its two leaves. The leaves are 6ft (2m) or more and channel dew into the ground above the plant's hage taproof Each plant is either male or female so can only reproduce if a plant of the opposite sex is nearby

is that the plant embryos are able to he dormant in hostile conditions, such as drought or winter, delaying the next stage of reproduction until favorable conditions occur

Sexual reproduction can give rise to botanical subspecies or varieties, whose characteristics deviate to some degree from the parent species. This is most marked in mountainous areas where some plants become isolated on a valley floor or alpine peak from the more widespread species. The potential for variation is more dramatic where plants are isolated by water, creating colonies on separate islands. Geographical isolation can also result in endemism: a species limited to one locality (see right)

In contrast, where two species from the same genus grow in the same area, they may cross-breed to produce natural hybrids. Arbutus x and achnoides grows wild in Greece and is a hybrid of two species, Arbutus andrachne and A. unedo

In the wild, plants disperse hundreds or even millions of seeds in order that a few seedlings might survive to maturity. In cultivation, a high yield of good quality seedlings may be obtained more quickly by providing them with as ideal an environment as possible (see The Propagation Environment, pp 38–45).

Humankind has also benefited from the genetic diversity of seeds, selecting forms that may have died out in the wild and developing from them plants with immense value in cultivation (see The Evolution of Bread Wheat, Jacing page) Seeds offer the potential to introduce an exciting range of plants with new forms of flower and leaf hardiness, habit



EXPENDE PLANT

The desert rose (Adentum obesum subspisocotranum) is found only on the small isidad. A Socotra, off the northeast African coast. The isle has been isolated from the continent for 1-6 unifor years and has over 250 endenic species.

adaptability for specific conditions and resistance to pests and diseases

However, seedlings may not be as suited to local conditions in the wild, or as garden-worthy in cultivation, as the parents. This risk can be reduced by the gardener, to some extent, by using seeds from known sources, where good-quality parents are selected and grown away from possible pollen contamination from inferior plants. Some seeds have a deep-seated or complex dormancy (see p. 19) as in Davidia involucrata, where seeds do not always germinate in any quantity in



one season or may take several years to reproduce. Other species may fail to produce seeds at all or yield seeds with low viability, such as Acer griseum

#### VEGETATIVE REPRODUCTION

Nature has overcome the limitations of seeds by adopting asexual reproduction also, producing offspring (clones) that are genetically identical to the parent Plants have many ways of increasing vegetatively from modified roots or stems. The simplest is by forming a mass, or crown, of shoots and buds, each capable of being a separate plant

Some plants can regenerate shoots or roots from growth tissue to produce new plants (runners or lavers). Others form specialized organs, including stem tubers (potatoes), corms (crocuses) and pseudobulbs (Cymbidium orchids), that store food (see pp 25–7). This enables a plant to survive unfavorable conditions and save energy for reproduction when favorable conditions occur.

Vegetative reproduction allows some plants to colonize an area more rapidly than by seeds, as any gardener who has encountered quack, or witch, grass (Agrapyron repens) knows. It is also useful to plants at the fringes of their natural habitat, where flowering and seed production are difficult. Blackbernes (Rubus fruticosus) rarely flower in dappied woodland, but they spread rapidly by tip layering (see p.24)

Gardeners have adapted natural vegetative, or clonal, reproduction to obtain plants that are always "true" to the parent (see pp 22–27). Methods such as division of herbaceous plants are even more reliable than seeds. Artificial ways of increase, such as by cuttings or air layering, have also been developed by exploiting plants' regenerative abilities.

Clonal propagation carries dangers, however Genetically identical plants carry the same susceptibility to disease The large UK population of English elms



NATURAL GRAFT In the wild, grafts

In the wild, grafts can occur between woody plants of related, thin-barked species if they grow in close proximity. Two branches on one plant may grow together, as on this Parrolia Grafting has been copied in cultivation as a way of propagation, atthough it occurs in nature accidentally, not as a true mode of reproduction





FROM THE WILD

10 THE GARDEN

Species can be increased selectively in cultivation to produce plants that hear bule resemblance to wild species. Meadow tulips, such as Tulipa australis (see far left) have been hybridized over many years to produce thousands of showy, large-planned cultivars, such as Tulipa Estetta Rijnveld' (lett.)

(Ulmus proceta) was destroyed in the 1960–70s by Dutch elm disease. The trees usually reproduce by root suckers so were represented by just a few genetically different clones. If the elms had increased by seeds, they may have varied enough genetically for resistant trees to have occurred

#### LEARNING FROM NATURE

Most plants have the capacity to increase sexually and asexually, which avoids disasters similar to that suffered by the English elm. This benefits gardeners, who can choose a propagation method to suit their needs and the capacity of each plant to reproduce in the local conditions.

The plant family can be a useful guide plants in the same family often reproduce similarly. For example, most plants in the Gesneriaceae, such as African violets (Saintpaulia), Columnea, Ramonda, and Streptocarpus readily regenerate from leaf tissue. The Menthaceae, including coleus (Solenostemon), sage (Salvia), Lamium, and rosemary, root easily from stem cuttings — in the wild, stems close to moist soil produce roots

Another factor is the plant's natural innit of distribution, often reproductive ability declines outside this area (see pp 36–7). This may be countered by providing controlled conditions (see The Propagation Environment, pp 38–45)

#### THE EVOLUTION OF BREAD WHEAT

The turning point for agriculture in the Old World probably came in the Middle East in 8,000 BC. A wild goat grass crossed with wild wheat (Triticiam monococcium) to form a rate, fertile hybrid with a larger east. The hybrid, called emmer (Triticiam dicoccium) was cultivated by the ancient Greeks and Romans because of its increased yields. In a second genetic accident, emmer crossed with another goat grass, the new fertile hybrid, with larger ears, was bread wheat For two consequent hybrids to be fertile is an amazing coincidence.

The wild grasses including emmer had long, thin stalks which snapped easily and cars which broke up into grains attached to hasks and were carried on the wind. This helped natural distribution of seeds, but made harvesting difficult.

Bread wheat had shorter sturdier stalks and ears that did not disintegrate. The ears must be broken by thrashing, and the busks removed as chaff while the plump grains fall to the ground. Therefore bread wheat needs help for its distribution and man and plant have come together for mutual benefit.





## PROPAGATION IN THE PAST

The cultivation and propagation of plants began when human tribes abandoned their normadic, huntergatherer way of life to live in settled communities. This change occurred just after the last ice age and marked the beginning of modern civilization. It is often referred to as the "agricultural revolution" but appears to have been mainly the result of a remarkable genetic accident that led to the development of bread wheat (see p 11). This biological intracle took place in about 8,000 at in the Middle East and was the trigger for the advent of farming

Ancient civilizations throughout the world grew a wide range of food crops, including grains, from seeds, after noting how plants initiately dispersed seeds that later produced seedings. In ancient Greek and Roman times, writers such as the poet Virgil recorded current methods of propagation in some detail. Oaves date palms, and expresses were grown from seeds as well as other food plants such as cabbages, turnips, lettuces, and herbs, fo speed up germinal on the tireeks soaked seeds in milk or houce seeds were asso projected with thin speeds of mica or a form of bell grass.

Origins of VEGETATIVE PROPAGATION
Propagation from cattings began when
rooted shoots or suckers were detached

and replanted. It is led to propagat on from unroated cuttings. Romans dipped the bases of cuttings in ox manure to stimulate rooting. In the Middle

East, settlers discovered how to propagate superior forms of grapes, olives, and figs to preserve their desirable characteristics by thrusting woody stems into the soil

By 2,000 BC, grafting was fairly common in Greece, the Middle East, Egypt, and China. The earliest form of grafting was probably approach grafting, because it has a high success rate. The branch of one tree, while still attached to the parent tree, was securely attached to the branch of another tree after the bark of each branch had been wounded. This mimics natural

Ancient Egyptian farming
This wall painting of Semedjem and
his wife in the Valley of the Nobies.
Thebes, shows that sowing grain seeds
in drills was practiced in ancient
Egypt. The mixed orchard of palms
and olive trees (below) was probably
grown from seeds or cuttings



AARON'S ROD B blical references to propagating plants, such as Auron's rod, abound Moses placed staves from the 12 leaders of the Israelites in the tabernacle "and behold, the rod of Aaron was budded. and brought forth buds and bloomed blossoms and yielded almands" (Numbers 17/8) and so Aanm was chosen. This is probably one of the corliest recorded examples of a hardwood cutting

gralting (see p. 11) and illustrates how coscly people were observing nature (traiting was used to propagate plants that were difficult to root from cuttings and to encourage early fruiting

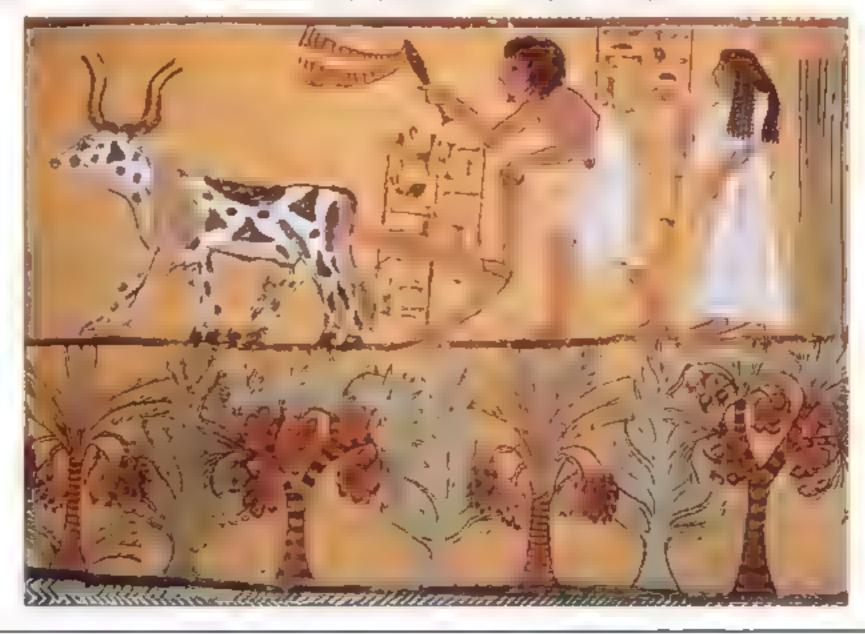
The Romans were among the first to practise detached scion gratting (see also p.2)—where a piece of the chosen plant is removed and inserted into a cut in a rootstock selected to provide vigor for the grafted plant. They used a variety of methods and may have even grafted a single rootstock with a number of different frait cuttivars, such as apples, to produce what is now known as a mustiple tree (see p.5)—the Romans and ancient Chinese also employed the technique of budding—see p.27

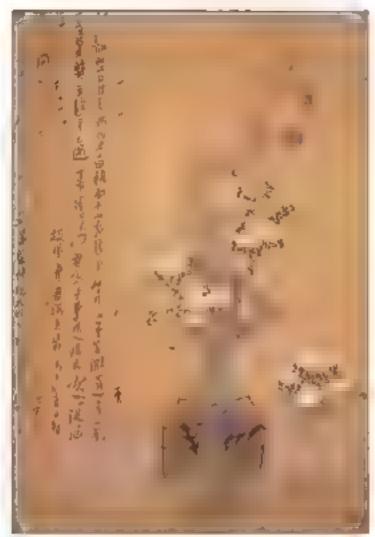
Other natural vegetative reproduction methods were exploited by propagating

from food-storage organs such as bulbs rubers, and rhizomes (see pp 25-27). Plants increased in this way included omon and garde. Mediterranean, sugar cane (tropical Africa), banana (India and Indonesia), pota-o and pineapple (South America), and bamboe. Asia

Simple avering was adapted from natural layering of wild plants over p.24). Records show that the Romans were layering grapes in the 1st century by Air layering (see p.25) probably began to be used 4,000 years ago in China; it is often still referred to as Chinese layering.

Toward the dawn of the first century applied propagation practices were already well established. Throughout the centuries that followed, these early propagation techniques were continually developed and improved.





CHINESE CHRYSANTHEMEN The ancient Chinese were expert gardeners particularly in the art of hybridization. Hybrids of treasured plants such as the chrysanthemion were created for the denght of Emperors

#### VICTOR AN INFLUENCES

An expression of plant-hunting took place in the western world in the 18th and 19th centuries. A wealth of new and exciting plants were discovered and traded between Europe and Japan. China, the East Indies, Australasia Africa, North America, Mexico, and South America. New introductions arrived as seeds, bulbs, or even plants

Enthusiasm for these new plants and the desire to grow and propagate them, coupled with the financial wealth of the plant collectors, was the inspiration for the golden age of the greenhouse (see right) Victorians were very inventive in both the construction and design. Their methods of controlling temperature and levels of light and humidity in the growing environment of the glasshouse were impressively complex

The greenhouse enabled the creative use of propagation methods and the refinement of techniques. The role of "propagator" became important for any garden of note. Initially, trial and error must have been used when attempting to increase stocks of each unfamiliar plant. Propagators were proud of their new knowledge and often guarded it jealously to secure their reputations and future employment. This may be the origin of the mystique which often surrounds plant propagation even today

The propagation equipment that was available to Victorian gardeners was fairly primitive compared to modern advances, yet their ideas still form the basis of what is done today. They used

#### THE POWER OF MANURE

Providing bottom heat for propagation is easy today with the aid of electricity, but solid-fueled boilers and hot-water pipes. were cumbersome and expensive in earlier times. One way of giving plants bottom heat, for propagation and forcing early crops, was the "hot bed," which came to prominence in the Victorian era. This ingenious but simple system relied on heat generated by microbial action on a mixture

of equal parts fresh manure and deciduous leaves

The hot bed consisted of a glazed frame placed in a pit, approximately 3ft (90cm) deep and 18m (45cm) longer and wider than the dimensions of the frame, filled with the manure mix. To activate the manure before filling the pit, the manure and leaves were thoroughly mixed moistened and leli for about two weeks. The pile was turned three or

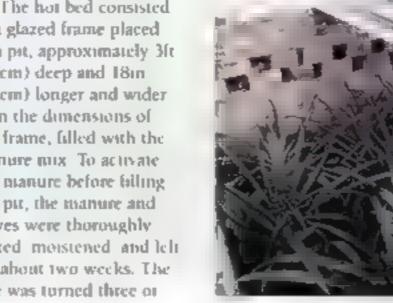
four times during this period to ensure even heating. It was then placed in the pit, firmed, and watered. The frame was placed on top and soil added to a depth of 8in (20cm), to spread the heat. Pots and trays of cuttings or seeds were placed on the soil

Hot beds are becoming popular again. as gardeners realize the value of heat from decomposition. For anyone with access to manure, and the space for a large pit, they

> are practical organic, and cheap (see p 41). A hot hed made in spring releases heat for up to eight weeks Manure with high straw content releases less hear, but over a longer period

#### HOT BED

Victorians gardeners often used hot body like this restored one in Cornwall England, for propagation and for raising tender vegetables or fruits (here pineapples) in winter



cold frames and hot beds (see above) to control temperature and humidity Cold frames, sited to capture as much warmth as possible from the sun, especially in winter, were used for seeds, root cuttings and easy stem cuttings

Bell jars were used in great numbers The bell-shaped glass jars, about 18m (45cm) tall, were placed over cuttings in prepared soil or in pots. Although difficult to control precisely, it was possible to maintain high humidity inside the bell jars. Warmth was provided by solar radiation. Bell jars were effective for raising small quantities of plants from seeds, stem or root cuttings, and even grafted plants. Today, bell jars have largely been replaced by more versatile

Toward the end of the 19th

century, gardeners split the

cloches (see p 39)

base of a cutting and

placed a wheat

the cutting in soil mix. As the wheat seed absorbed water and began to germinate, it released growth-promoting substances These helped the cutting root more easily and with more vigor. The practice became obsolete after 1940, following the introduction of synthetic rooting hormones, or auxins (see p.30). Gardeners also understood the need

seed inside the cut stem before inserting

for seed treatments such as scanfication in the days of fob watches, pea seeds were carned in the vest pocket so they became scratched by the watch

#### GLORIOUS GREENHOUSES

With the advent of the heated greenhouse in 18th-century Europe, temperature light and Jaonabty cound be controlled. This extended the range of plants that could be propagated, as in this tropical givenhouse,

# MODERN PROPAGATION

Cince the 1950s, modern technology and an increase in the exchange of information among professionals has led to the development of new propagation techniques for the first time in centuries. These new methods, together with modern equipment, make propagation much easier today. Continuing research regularly opens up more possibilities in propagation; these are first tested by professionals and, if they prove worthwhile, eventually benefit the gardener

#### MIST PROPAGATION

The intermittent mist propagation system (see below) was designed in the 1950s for rooting stem cuttings, particularly of softwood and semi-ripe material The unit provides bottom heat to stimulate rooting and constant regulated humidity to keep the cuttings moist and cool. This advance allowed up to six batches of cuttings to be taken per bench per year, and many plants that had previously been grafted could be rooted, at a fraction of the cost

Today, instead of a soil thermostat digital sensors spaced evenly through the bed and linked to a central system are often used. Mist is provided when the mist-control sensor placed at the level of the cuttings indicates a fall in the moisture-film level on the cuttings

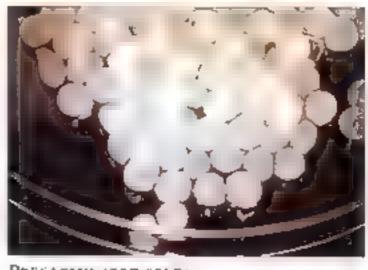
Mist propagation is widely used in commercial propagation and is useful for gardeners. If you cannot afford a dedicated unit (see p 44), create your own version with soil-warming cables and a misting system in a closed case

#### PLASTIC FILM

Another development of the 1950s was plastic film. Cuttings are provided with bottom heat and the plastic film (a sheet of clear plastic) is draped over them in order to create a scaled environment, which maintains high humidity around the tops of the cuttings. This system is easily adopted by gardeners, although rotting can be a problem in cool temperatures. Plastic film can also be used with cold frames to warm soil before cuttings or seeds are inserted and then to cover new plants in the frame

#### FOG PROPAGATION

The main development in the mid-1980s was fog propagation, which provides a much smaller water droplet than mist propagation, so that the air remains moist for a much longer period. It also avoids wetting the foliage, as in mist propagation, so is ideal for cuttings or seedlings that are prone to rot. In recent years, log systems have been simplified and made more reliable (see p.44)



PREGERMINATED SEEDS

Pregerminated seeds there of alluna, a caule folder crop) can be kept moist and supplied with matricuts by embedding them in beads of gel. The tiny seedlings grow unchecked before sowing

#### SEED TREATMENTS

Seed priming exploits the natural ability of some seeds to halt development if soil conditions are unfavorable. It improves speed and uniformity of germination Seeds are started into pregermination with a controlled amount of water and then redried just before the radicle (embryonic root) emerges. Timing of the treatment is critical. True germination does not occur until the seeds are sown

In commerce, seeds are germinated or chitted, until the radicle emerges, then packed, sometimes in gel (see above), and sent out for immediate sowing. Gardeners can also clut seeds, it is very useful for hard-coated seeds, especially of vegetables (see p 282)

Pelleted seeds are coated with an mert material, such as a polymer, that splits or softens on contact with water The coating may contain fungicides, nutrients, and a fluorescent dye. The pellet makes sowing easier, particularly with small seeds, thus reducing losses

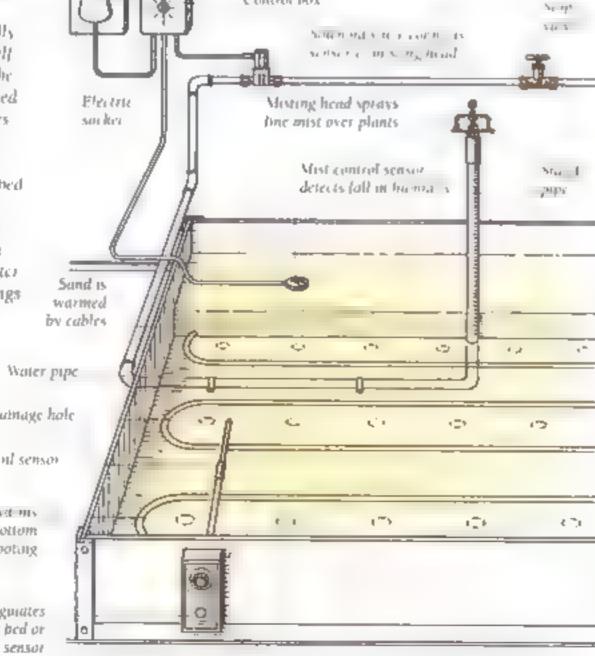
#### MICROPROPAGATION

This technique, developed in the 1960s, is used to propagate huge numbers of plants from a small amount of materia. It enables plants that are difficult to propagate by traditional means, new cultivars, and virus-free stocks of crop plants such as raspbernes, to be made available to gardeners. To conserve plants in the wild, old and rare plants can be increased from existing stocks.

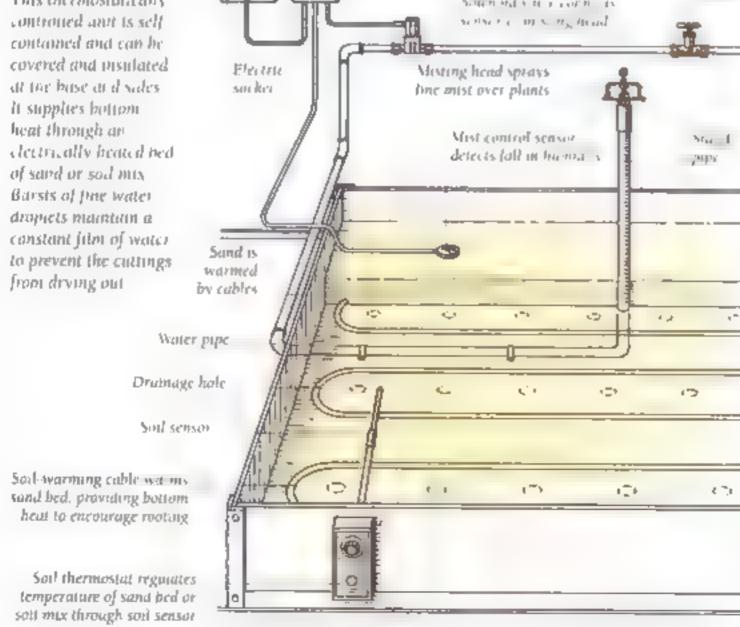
Micropropagation usually involves growing pieces of plant tissue in vitro (in glass) in sterile laboratory conditions (see top of facing page). This is possible because of the abinty of most plants to regenerate from a single cell. Tissue from the shoot tip (meristem) is most often used, but root tips, calluses (which form on wounds), anthers, flower buds, leaves, seeds, or fruits may also provide suitable tissue. Temperature and levels

#### M ST PROPAGATION UNIT

Ints thermostatically controlled and is selfcontained and can be covered and pisulated at the base at d sides it supplies bottom heat through an of sand or soil mix Barsis of time water dropiets maintain a constant film of water



Control box



#### MICROPROPAGATING FROM PLANT CELLS



CULTURED PLANT TISSUE Plant cells (here of tobacco) are grown on a marrent gel total the cell mass produces embryo plants



CUTTING LP CULTURED TISSLE
The mass of plant tissue is cut into
pieces, each with one embryo, then
transferred to a rooting medium.



ROOTING PLANTLETS Hormones in the nutrient gel encourage the plantlets there sundews) to produce roots and shoots like seedlargs



YOUNG PLANTS Plantlets then orchids) are grown on in scaled sterile flasks until they are large enough to transplant into pots

#### OTHER FORMS OF MICROPROPAGATION

The sterile conditions of micropropagation can be tised to gain better yields and preserve disease free stacks by adapting methods already used to increase plants. Plantiets are grown from they leaf cuttings micrombers can be easily transported; on had seeds have a much improved survival rate of protected from airborne bacteria.



ALRICAN MODET DEAF CUTTING



POTATO SHEROTUBERS



ORCHED SEEDLINGS

of light, nutrients, and hormones are regulated in specially adapted growing rooms. The resulting plants are grown on in greenhouse conditions. Viruses and systemic disease rarely penetrate growing tips, so micropropagated plants are normally disease-free and may be safely introduced to other countries

There are some disadvantages to micropropagation it is costly, bacteria and viruses may not always be totally eradicated, plants may show genetic mutations, and plants may fail to adapt well to a normal growing environment

#### THE FUTURE OF PROPAGATION

New scientific discoveries continue to affect plant propagation. The benefits of these techniques are not always yet available to gardeners but may be in the future. Recent innovations include genetic engineering – a controversial area – artificial seeds, and micrografting.

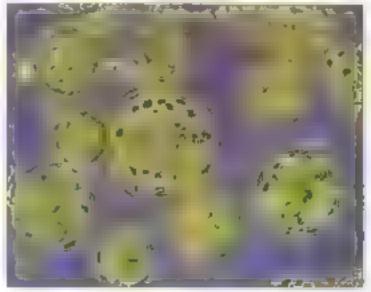
In genetic engineering, foreign genes with known, desirable characteristics are transferred into another plant cell (see right) It is possible to introduce a gene that is totally unrelated to the recipient plant – unlike natural hybridizing and traditional selective breeding, both of which also result in offspring that are genetically different to the parent plants

The technology, involving molecular biology, is very complex and not without problems. An average plant has 20,000 different genes, of which there may be five million copies in a single cell, so determining which gene is responsible for which characteristic can be difficult. The minute scale of the gene transfer operation demands special techniques. The limished cell is micropropagated to produce a stock plant for propagation.

Genetic engineering has immense potential to enhance the usefulness of existing plants and to create new ones. Current work is aimed at improving resistance of crops to disease, cold, and pests. Successes include potatoes that do not suffer cold damage and canola that yields more oil. There are concerns, however, about the consequences of introducing plants that could never occur in nature into the environment.

Naturally fertilized seeds contain genes from two parents; no two seeds are identical. It is now possible to create artificial seeds (somatic embryos) from vegetative tissue. This involves isolating embryos – grown in solution from single cells – and giving them a synthetic coating. Vast numbers of genetically uniform "seeds" can be produced, which give rise to genetically identical plants.

In micrografting, minute pieces of plant tissue are used to produce disease- and virus-free plants, especially fruit trees hirst, seedling rootstocks are raised in sterile conditions. When a seedling reaches the first true leaf stage, it is micrografted with the tiny, virus-free tip (menstern) of the desired plant. After about six months, micrografts are ready for normal planting. Virus-free, micropropagated (clonal) rootstocks may also be used to avoid the variability that can occur with seedling rootstocks.



GENETIC ENGINFERING

Plant cells (he of tobacco) are chemically treated to remove their tough outer cell walls. Genes from other plant cells are then introduced into the cells, and the outer walls are regrown.

# SEXUAL INCREASE OF PLANTS

The seed is the basic biological unit for the reproduction of comfers (gymnosperms) and flowering plants (angiosperms). Each seed combines male and female genes in a plant embryo and gives rise to offspring that varies generically from the parent plants. By this means, a species can preserve and perpetuate its identity yet constantly exchange genetic material within the species so that it can evolve and so adapt to changes in the environment.

Seeds also enable a plant to colonize a large area and can he dormant until conditions are favorable, which greatly increases their chances of survival Understanding how seeds are formed and dispersed and how they germinate is essential to successful propagation

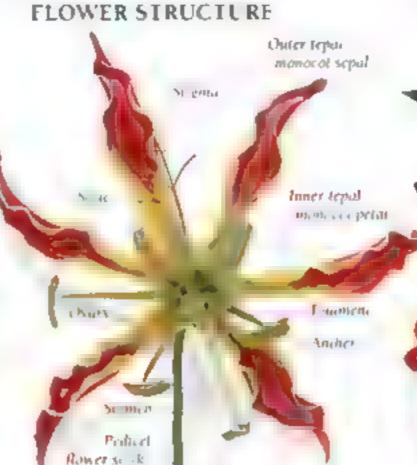
THE STRUCTURE OF THE FLOWER
In angiosperms, the process of seed
production begins with the flower
a structure that contains either male
or female sex organs or both. Most
flowers are composed of inner petals
and outer sepals, collectively called
tepals or perianth segments, they may
show great diversity in shape and color

The Talipot palm (Corypha umbraculifera) produces a massive cluster of thousands of flowers (inflorescence) at the apex of the palm. The plant is monocarpic: after flowering once, the palm dies, in contrast, the largest single flower in the world is produced by Rafflesia, a tropical parasite that has no leaves and blooms directly from the roots of the host plant. These flowers can measure 32in (80cm) across Between these extremes are the flowers of more familiar garden plants such as irises and daisies.

#### POLLINATING AGENTS



INSECTS Many flowers, such as this loofah (Luffa acutangula) are large and brightly colored to anract assects such as beetles Rope pollen is sticky it adheres to the beetle's carapace until it is carried to another flower



The female overy in a m-mocot flower there a gloriosa) gives rise to the seeds in a fruit. The style connects the overy with the steemal which receives pollen. Stamens form the male part of a flower each is composed of a filament supporting an anther, which produces pollen

The female reproductive part of the flower, which produces the seeds within some sort of fruit, is the ovary. The style a slender stalk, connects the ovary with the stigma, which receives pollen. Ovary style, and stigma form the carpel (or pistil). There may be one or several carpels, always at the center or apex of the flower Surrounding the carpels in a bisexual flower (see above) are the stamens, the male part of the flower Most stamens have a slender filament that supports the anther, where pollen is produced. Other flowers are single-sexed and have only stamens or carpels



BATS Several bots feed on nectar, especially in warm climates. Some cactus flowers bloom only at night and emit a powerful foul smelling scent especially to attract the bots. The pollen is then transported to other flowers on the bots fur

#### SEXUALITY OF FLOWERS



Some plants have bisexual flowers with stigmas and stamens. Other plants are monoectous, with separate male and female flowers, or dioectous with flowers of only one sex borne on each plant.

(Schlumbergera)

#### **POLLINATION**

Be goothi

Before it can produce seeds, the flower must first be pollinated. Pollination is the transfer of (male) pollen from the anther to the (female) stigma if a plant pollinates itself, instead of receiving pollen from another individual of the same species, genetic variation in the seed is reduced. The majority of plants, especially wild species, have systems to prevent self-pollination

With some flowers, their anthers and stigmas ripen at different times so that even if pollen drops onto the stigma of the same flower, it simply dies. Some (monoecious) species such as hazel (Carylus) and corn (Zea mays) have single-sex flowers of both sexes on the same plant. Sometimes they are on separate parts of the plant, as with corn, where the male flowers are grouped at the top of the plant to catch the wind. This favors cross-pollination, although self-pollination is still possible.

Other (dioecious) species separate male and female flowers by locating them on different individual plants Examples include hollies (ilex), poplars (Populus), willows (Salix), the shrub Garrya elliptica, and date palm (Phoenix dactylifera). Many dioecious plants are wind-pollinated. A danger of this method, in nature is that an isolated plant may be unable to set seeds.

The disadvantage of dioectous plants for gardeners is that it may be at least five years before plants raised from

seeds flower and may be sexed. Female (berrying) hollies cannot be selected for 7 20 years, for instance. In contrast, males of many willows (Salix) are more garden-worthy than the females because their catkins are larger and showier

#### **POLLINATING AGENTS**

To ensure cross-pollination, plants have evolved a wide range of ingenious techniques. They often exploit insects or animals to transfer pollen from one flower to another (see facing page). The creatures are attracted by scent or by colored or large petals and rewarded with nectar, protein-rich polich, or fleshy petals. Orchids have some of the most bizarre mechanisms, including flowers shaped or smelling like female insects to lure male insects into attempting to mate with the flowers. Bats, beetles, bees, butterflies, flies, small mammals, and moths are all agents of pollmation

Some plants have two or three kinds of flowers, which look similar The prominence of stigmas and stamens ditlers, however, as with primroses (Primitia virigaris), so that an insect can pick up pollen only from the stainens. of one flower or deposit pollen on the stigma of another flower

Other plants use wind or water to transfer pollen, so the flowers are often less conspicuous because they need to offer no "bribe," but these methods are more wasteful and erratic

#### FERTILIZATION OF A FLOWER

For fertilization to occur, pollen must be compatible and alive. The stigma must also be receptive, usually it exudes a

Name of S

Swelling

#### HOW SEEDS DEVELOP

POLLINATED FLOWIR Once the flower has been fertilized. the petats begin to lade and then Juliand the overy begins to swell. The stie we and stantens wither and day. The fertilized egg ceils (ovules) within the ovary each develop a seed coat (testa) to protect their embryos, white the ovary wall forms a

> protective layer spericary, around the seeds Together the seeds and pericarp form the friat. It may be succident, when the middle layer of the pericarp becomes thick and fleshy as with the rosemp, or dry and hard or papery. As the seeds mature, the ripening fruit changes cotor. Fleshy fruits often ripen from green to a bright cotox.

#### MONOCOTYLEDONS AND DICOTYLEDONS

Seed cout (testa) Service Land Seed leaf trotyledon Emberone shoot (plamule Embryonic tool radii (c)

BROAD BEAM (Victa faba)

DICOTYLEDONOUS SEED. This germinating seed has two seed leaves, protected by a seed coal. The seed leaves make up the embryo. together with the tiny root and shoot at their base. Sometimes (as in this broad bean) the seed leaves contain food storage (endosperm)

Flowering plants (angiosperms) are divided into two groups. Monocotyledons have one seed leaf (cotyledon) usually parallel veins on the leaves, indistinguishable petals and sepals in multiples of three, and nonwoody stems. Dicotyledons have two seed leaves. nothke years on the leaves, of on small green sepals, petals usuany in multiples of four or five, and thicker stems that may have woody tissue, formed by the cambium





MONOCOTILEAE

DICOTULAL

sugary solution and becomes sticky. This causes the pollen grains to stick, it also provides nutrients for the pollen grain to germinate. If the pollen is compatible, it will then grow and form a pollen tube. The tube burrows down the style so that male sex cells can enter the ovary and fernilize the female egg cell (ovule)

Both the male and female sex cells contain chromosomes (which hold genetic material) from each parent plant, but in only half the quantity of that in an adult plant. When a male sex cellfuses with the single egg nucleus, and the full set of chromosomes is effected seeds begin to form

THE STRUCTURE OF SEEDS

FADING BLOOM

RIPE

SEEDS

Fully developed seeds usually consist of an embryo - a tiny plant with a shoot (plumule) and a root (radicle) together with seed leaves (cotyledons) - that is surrounded by a mass of food (endosperm)

or testa - protects the embryo and its food storage from attack by fungt, bacteria insects and animals, and from any environmental stress such as drought. flooding, and low and high temperatures. The maturing seed usually dries while on the plant to prepare it for a period of harsh conditions. Achieving the correct degree of dryness, or maximum dry

to germinate in most cases The amount and size of seeds varies immensely: some are as fine as dust

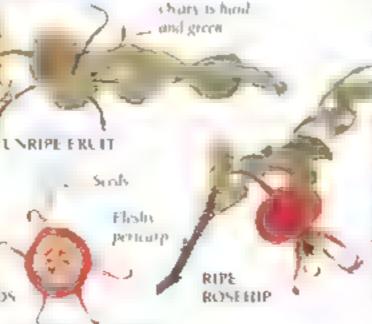
weight, for the embryo at full maturity is

thought to influence the seeds' capacity

The protective casing and fertilized seeds form the fruit (see left)

**GYMNOSPERMS** 

Unlike angiosperms, the "naked" seeds of gymnosperms such as conifers are only partly enclosed by tissues of the parent plant. Confer cones (see also p. 71) are wind-pollinated, and seeds form on the scales of female cones. Other gymnosperms include eyeads (see also p 68) and ginkgos (see p 80)



in some plants, the seed's endosperm completely surrounds the embryo and forms the storage tissue of the mature embryo, as with onions (Athum). It may also act as a temporary food reserve within the seed leaves to nourish the embryo in the early stages just after germination, as with broad beaus (see above) and sweet peas (Lathyrus)

In angiosperms, the endosperm develops before the embryo, but in most gymnosperms, the embryo forms first A hard outer laver – the seed coat

#### SPORE-BEARING PLANTS

Plants such as mosses, liverworts, ferns, club mosses, and horsetails reproduce by spores. A spore may look like a seed but is asexual and develops male and female sex organs independently from the plant that bore it. The consequent sexual stage of reproduction can occur only in the presence of water (see also Ferns, p. 159)

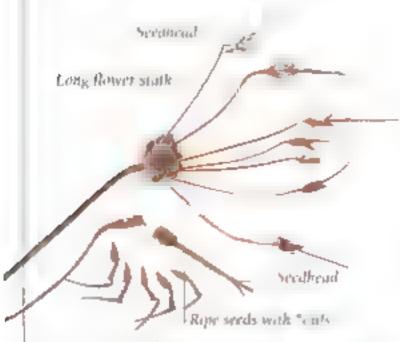
#### METHODS OF SEED DISPERSAL

Once seeds have matured, they must be dispersed, if they all germinated close to the parent plant, they would compete for water, light, and nutrients. Plants have developed various strategies to ensure that their seeds are dispersed far and wide – one of the advantages of seeds over vegetative propagation

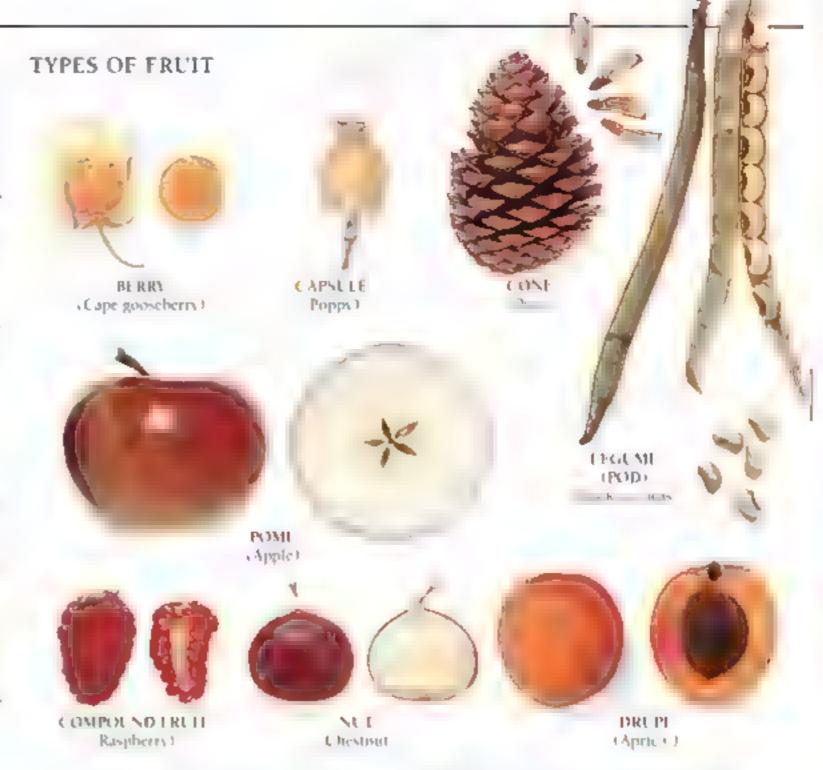
The fruits or pods that contain the seeds have adapted to different dispersal methods. Some fruits are very simple and look like a big seed, such as the oak acorn (Quercus), which has a thick shell to protect the true, thin-coated seed inside. Acorns are resistant to physical damage and can survive rolling around the ground and being buried by animals

Some seed coats develop into papers capsules or pods, as are produced by milk-weeds and delphiniums, the pod dries unevenly as it ripens, causing tension in the pod walls that eventually splits it open to release large numbers of seeds. The seeds either drop to the ground or are carried off on the wind (see below).

Other seed pods, such as those of Acanthus witch hazel (Hamamelis), and peas (Pisum), burst explosively to expel the seeds over quite some distance. The successful weed, hairy bittercress (Cardamine hirsata), needs only to be touched or blown gently by the wind to cause its seed capsules to burst and eject seeds. The Mediterranean squirting cucumber (Echanhum elaterium) has a



HERON'S BILL (ERODH M MANESCAVII) SEEDS Each seedhead consists of five seeds with "tails." Ripe seedheads fall apart, and the seeds drop onto the warm soil. Each tail coils tike a spring within ten manites, enabling the seed to screw itself into the soil. The process can be triggered by placing a seed on the warm palm of the hand



pod that fills with liquid as it ripens until the pressure bursts the pod from the stalk, expelling a stream of seeds and juice as it flies through the air

Seeds of some plants, for example grasses and amaryllis (Hippeastrum), germinate as soon as they ripen, even while still on the parent plant if conditions are suitably wet. The germinating seeds then fall into the moist soil and grow immediately

#### SEED DISPERSAL BY ANIMALS

Plants often have fleshy fruits to tempt animals to visit the plant and provide something for the animals to eat. The animals do not then need to digest the seeds, which often have more nutrients The seeds pass unharmed through an animals digestive system and are deposited in droppings (a ready-made seedbed) far away from the parent plant Fleshy fruits include berries (grape, Vitis), drupes, or stone fruits, with single seeds (plum, Prunus), and pomes with several seeds (apple, Maius) Compound fleshy fruits include the pineapple (Ananas) and raspberry (Rubus idacus), strictly collections of drupelets.

Many seeds and fruits have various appendages that are capable of latching onto animal hair or feathers, some very tenaciously. Such seedheads may be transported over a great distance before the unfortunate animal is able to dislodge them. The burrs of burdocks

(Arctium) and cleavers (Galium) ching to fur and clothes tenaciously

#### WIND DISPERSAL OF SEEDS

Many seeds are very small and carried by the wind. It is an economical method of transport because it demands less energy from the plant to produce a light, tiny seed than a large one with a fleshy fruit. Minute seeds are produced in great numbers to compensate for the reduced likelihood of landing on suitable soil.

Rhododendrons, and especially orchids, have extremely light seeds, which are carried on the wind. Other seeds have developed structures to keep them airborne. The seeds of willowherb (Epilobium) are plumed (see facing page), those of dandelions (Taraxacum) and lettuce have featherlike parachutes. Ailanthus, ash (Fraxmus), and mapies (Acer) have prominent, papery wings that spin like helicopter blades (these winged seeds are known as samaras).

#### SEED DISPERSAL BY WATER

Plants that have adapted to growing in water or alongside watercourses produce seeds or fruits that are waterproof and buoyant. Seeds of the swamp cypress (Jaxodium distichum) may be carried away by streams and rivers before they germinate. One of the most successful travelers on water is the coconut fruit (Cocos nucifera), it can survive a voyage across an entire ocean (see facing page).

#### METHODS OF SEED DISPERSAL



ON THE WIND SOME phorispinta ts seedh eds that contan-What will be a plantes, such as this 1424 1 4 41 11 \* Suchillia 10 15 0 to 0 The plantes ename the seeds to be carried over long distances on the word in this year the profession for a A-FA (cD) to a con-



BY SEA. The cocon it perm grows on the shore s. some froits drop arto the sea. An trapped withou the tibers of ascouter mosk makes a corount very buoyant, allowing it to dolf on ocean currents, is germanates when washed up to a local state of state

#### SEED DORMANCY

Seeds are regarded as being dormani if they fail to germinate when placed under conditions that are considered adequate for the species. The conditions include adequate temperature, moisture air, and, in some cases, light If these are present, nondormant seeds should soon germinate after absorbing water

In areas where the seasons alternate between warm sammers and cold . winters, or where dry and wet seasons persist, dormancy prevents seeds from germinating as soon as they are ripe at the end of the growing season. The seedlings would be killed either through extreme cold or heat or from drought Dormancy also results in staggered germination of seeds in the wild, thereby reducing competition between seedlings.

Seed dormancy is usually caused by a hard seed coat (pericarp), an immature embryo, or chemical inhibition of the

embryo. According to the difficulty with which the dormancy is broken, it is also described as shallow intermediate or deep-seated dormancy

Gardeners can overcome dormancy in several ways (see below). When dormant seeds have been primed for germination. they must be kept stable. Any change in conditions, such as increased hear dryness, or lack of oxygen, will prompt the seeds to enter a secondary dormancy which is extremely difficult to break

#### SEED-COAT DORMANCY

Some seed coats contain waterproofing that is gradually broken down by low temperatures. Further decay of the seed coat is caused by bacteria and lungi in the soil. Until a seed absorbs moisture, it will not germinate. Drying of a seed coat as it ripens can also cause dormancy

Physical degrading of the seed coal scatt reactions all ows moisture to react the seed embryo. This can be achieved by rubbing seeds against an abrasive surface such as sandpaper. Large seeds can be chipped with a knife. Only a small area should be removed, and care must be taken not to damage the seeds Crack large nuts carefully in a vise Commercially, seeds are soaked in acid but this is too dangerous for gardeners

Collecting seeds as soon as they are fully developed, but early in the development of the seed coat, reduces the time needed to decompose the seed coat so germination is more reliable

Primula seeds germinate almost at once if sown while fully majured but before they dry. They are much slower to germinate once dry and released from the pod naturally If hornbeam (Carpinus betalus) seeds are left on the tree until midwinter the seed coats harden and delay germination for 2-3 years

Seeds with a water-repellent covering on the seed coat, such as Gleditsia and Fremontodendron, may be soaked in hor water. This extracts the waterproofing. allowing the seeds to absorb water

Subjecting the seeds to a temperature thange - called stratification after the practice of chilling seeds in layers of sand - either before or alter sowing is the simplest and often the most effective option, emulating in part the natural process. Seeds of alpine plants and many trees and shrubs respond well to this

The period of chilling depends upon the severity of the dormancy. Seeds with shallow dormancy may need 3-4 weeks those with intermediate dormancy need 4-8 weeks, and those with deep-seated dormancy between 8-20 weeks. Once 30 percent of seeds have embryo roots they can all be sown

#### EMBRYO DORMANCY

With some plants, such as orchids, holly cliex) and some Viburnum, the embryois not fully developed when the seed is ripe. This results in complex dormancy Seeds with rudimentary or immature embryos will not germinate after seed dispersal until the embryo develops further. This is normally achieved by subjecting seeds to warm temperatures for 60 days at 68°F (20°C) as is received during the first summer following the dispersal of tipe seeds in nature

Once the embryo has fully matured germination may follow, but the seeds may also have seed coat or chemical dormancy as with Fraxinus excelsion and peontes. These conditions can be relieved by natural or artificial chilling of 8-20 weeks at 34-36 T (1-2°C) for germination in the second spring

#### CHEMICAL DORMANCY

Seeds borne in fleshy fruits, such as those of magnolias roses, or Sorbus are often inhibited from (continued on p 26).

VIABILITY OF SEEDS Seeds, according to their habits in the wildand moisture content, have differing all, spans. Some, especially fleshy seeds, die very quickly so need to be sown as soon is they ripen others, particularly dry seeds. such as those of beans or tomatoes, can be kept for up to ten years. Correct storage n dark dry conditions below 39°F (4°C) can preserve viability but exposure to higher temperatures or increased lumindriv may kill seeds at an aurage premature A THE BARE PR it in ligalities seeds post ce IN THE STEELING DCW 11 1 15 r Hant

#### BREAKING SEED DORMANCY



HEAT AND SMOKE Plants native to areas that experience bush tipes have seeds that se a he dormant until f destroys compening plant life. The hear of bush frees musics the hand fruits of some plants, such as Banksia, pop open to release the seeds Chemicals in seven в іздет дегопиаціон m seeds of plants such STHESS DOT



ANIMALS Some seeds, such as units, have very card outer cours. These protect the seeds but also prevent monsture from reaching the seeds. Animals such as this squarrel eat some mits but only damage the shells of others. Water can then pass through to the seeds and matain 300 metron.

(continued from p.19) germinating by a chemical suppressant in the seed coat it is normally degraded during passage through an animals gut. To overcome this dormancy, the flesh should be cleaned off the seeds before they ripen

Some seeds are triggered to germinate by chemicals in smoke. This happens in areas that experience bush fires, such as Australia and South Africa Chemicals in the smoke prompt seeds to germinate when existing plants have been burned off, thus reducing competition for the seedlings. Previously, some seeds were treated by direct heat, which worked as long as smoke was generated. Now difficult-to-germinate seeds can be smoked in large numbers without heat or soaked in chemical solutions. Fire also acts to crack or damage the hard coats of seeds, such as those of the wattle (Acacia), facilitating germination

CONDITIONS NEEDED FOR GERMINATION Before a dried seed can begin to grow it must be rehydrated water causes the seed coat to swell and burst. Most

seeds double in size before germinating. Development of the seed embryo is a complex biochemical activity, and large amounts of oxygen are needed to unlock the seeds energy reserves. If the soil or soil mix is frozen, compacted waterlogged, or baked hard, oxygen will not reach the seed embryo, and it will not be able to respire ("breathe")

Usually germination is prompted by temperatures typical of spring in the plant's natural habitat, allowing the seedlings time to become established before the following winter. Suitable temperatures vary considerably. Fractitis excelsion germinates at 36°F (2°C) if its complex dormancy has been overcome. In contrast, seeds of zonal geraniums germinate best at 77°F (25°C)

A median temperature for flower and vegetable seeds from temperate climates is usually 46–64°F (8–18°C) or 59–75°l (15–24°C) for plants from warmer climates. Germination can be delayed in high temperatures. Supplying heat in excess of that needed for germination by artificial means is wasteful and costly and may cause a secondary dormancy

Some seeds need light for germination, especially very fine seeds that have little or no food reserves to nourish the embryo. These include cress (Lepidium sativum), lettuce (Lactuca), and birch Betula). Artificial light can be used (see p 42), but it should suffice to cover sown seeds lightly with soil mix or top-dress with vermiculite to expose them to natural light during spring and summer

Nearly all seeds, if sown too deeply either die in time or become dormant because they cannot recognize when the surface light is sufficient for growth. As a rule of thumb seeds are best covered to no more than their own depth.

Some seeds can detect the levels of red in light to avoid germinating in shade, such as under trees, where the green leaves absorb red light waves

#### HOW A SEED GERMINATES

There are two basic ways in which seeds germinate (see below). Plants such as the iomato (Lycopersicon) and beech (Fagus) emerge by elevating the seed leaves above the surface (epigeal germ nation at the same time as the root radicle develops. If the shoot tip is frosted or killed, no further growth is possible

Hypogeal germination occurs with plants such as the pea (Pisim), oak (Quercus), and some bulbs, when the seed leaves remain in the soil with the root. The growing shoot emerges only when the first true leaves form. If the seed is buried deep enough, it has a good chance of survival if the shoot tip is damaged and can produce a secondary shoot or shoots. Hypogeal germination causes difficulty for gardeners because it may be many months after germination before any sign of growth is visible.

Once germination begins, if the optimum levels of moisture, light, air, or warmth change, the seed will quickly die

#### HOW A SEED GERMINATES



Hypogeal Germination Once the root marges, the embryonic shoot (plumule) is pushed upward, leaving the seed leaves behind in the soil. The plumule than emerges above the soil and produces its first true leaves



EPIGEAL GERMINATION The growth of the seed's root pushes the plumule and its protective seed leaves out of the soil. The seed leaves an borne at the tip of the growing shoot until the terst true leaves are produced.

#### HOME SEED GATHERING

As a general rule, if gathering seeds from the garden, they should be from a species. not a hybrid. Seedlings from a hybrid. (unless stab lized to breed true to type) will be extremely variable; some may be as good or even better than the parent but lew will he the same Torany, gather seeds from a vigorous plant with typical characteristics that seeds problecally. If the plant is isolated from similar species, the risk of natural hybridization is less and the seedings



GATBERING SPEDS Gather seedheads there n norlyhocks, Alcea) as soon as they ripen, then clean the seeds for storing or sowing

should "come true," closely resembling the parents. The advantages of home-gathering seeds are various

- Seeds with low viability have a better. rate of germination if sown fresh
- · Gathering seeds at the point of ripeness can avoid seed-coat dormancy occurring Early collection also enables presowing treatments that break complex dormancies to have effect before the most suitable sowing date for germination
- A large number of plants may be obtained at little cost
- Seeds from the garden often-produce plants that are better adapted to local conditions Home gathered vegetable seeds may be particularly adaptable. A hardy parent does not necessarily produce hardy offspring, but it is more likely.
- Increasing stocks of rare plants from gathered seeds helps conserve plants in the wild by reducing demand
- Stocks of plants, especially vegetables. that are no longer available commercially may be preserved and genetic diversity within the genus promoted

HYBRIDIZATION

The exchange of maternal and paternal genetic material in plants by the sexual. production of seeds, is fundamental to a plants ability to adapt to environmental change, but it can be exploited to breed new plants (hybrids) with improved color, form, habit, disease resistance, or scent to suit the needs of gardeners

A hybrid is a cross between two different plants. The differences may be minimal if the hybrid is between two selections of the same plant, or they may be more significant if the cross is between two species. Occasionally, the hybrid may be between two different genera. (A cultivar – short for cultivated variety - may be a hybrid but is not necessarily so It may be a named form of a species, such as a variegated sport. that first arose in cultivation )

If hybrids are produced from crossing two unrelated plants, the offspring often have great vigor, in the same manner as mongrel dogs are often very healthy Conversely, if plants are self-pollinated for several generations, they tend to lose vigor, as in inbred pedigree dogs.

in commercial hybridizing, parent plants are screened over time to ensure that they are stable and will breed true Two parents that each show some of the desired traits are selected. One parent is usually then chosen as the seed (female) parent and the other as the pollen (male) parent. Flowers on the seed parent have their stamens removed as soon as possible to avoid self-pollination and are hand-pollmated with pollen from the of each seed. The seed parent is also protected from contamination by insect pollinators by covering each flower with a bag or by keeping the plant under cover until seeds form

The first hybrid (F1) generation is uniform (see below), If the F1 hybrids are crossed, the second (F2) generation will present the grower with a range of forms reflecting both parents, the F1 generation, and others. Often, the offspring are selected and hybridized with another plant to introduce further traits, or with siblings or one of the

pollen parent to guarantee the parentage

#### original parents to further reinforce





desirable characteristics. F1 hybrids are frequently disease-resistant and offer a guarantee of performance but they tend to flower at the same time and the seeds cost more than F2 seeds. For the vegetable grower, F1 seeds ensure a good crop. F2 or species seeds can give herbaceous flowering plants of good quality that flower successively

HOW TO HYBRIDIZE A GARDEN PLANT Breeding a commercially successful and stable hybrid is usually an expensive and laborious task, but the amateur gardener can have fun experimenting with this technique. Some genera, such as dahlias, mses, or roses, lend themselves to hybridizing on an amateur scale, often producing quite pleasing seedlings Indeed, many hybrids that are now on the market were originally produced by amaieur gardeners

Home hybridizing is not very complicated but requires a methodical approach and a great deal of patience It helps to concentrate on one species or genus. Have a specific aim, say to produce larger-flowered red-hot pokers that are hardy to -36°F (-20°C) or a range of double-flowered Oriental poppies. Do some research to find out if any characteristics that you are aiming for in the hybrid are evident within the species or genus. Then select parents that may be of interest and start hybridizing, crossing and backcrossing. selecting and reselecting the progeny

Although plants differ in their flower forms, the hybridization procedure is basically the same (for details, see Roses) pp 116-7) Useful tools include small, fine paintbrushes for transferring pollen, a pair of strong tweezers and line, sharp scissors, labels, fine net or muslin bags to place over pollinated flowers, and a notebook to record all the crosses.

So easiful technidizing requires two parent plants here snapdragons) with stable characteristics, usually species or selections of a species from the same genus or, less aften, species from two genera. When crossed, the parents will produce offspring with uniform characteristics, and the results will be the same from subsequent crosses This first generation is called the first falial or FI hybrid. If the FI hybrids are cross-bred with themselves, the second generation, or F2 hybrids, will exhibit a range of forms with characteristics reflecting both the parents and the F1 hybrids in varying degrees







SECOND-FILIAL (F2) HYBRIDS

# VEGETATIVE PROPAGATION

In nature, some plants can reproduce Lasexually, or vegetatively, as well as sexually from seeds. The new plant is nearly always genetically identical to the parent (a clone), although minor mutations can occasionally occur-Vegetative propagation exploits this natural ability and extends it to involve the separation of vegetative parts of plant tissue such as roots, shoots, and leaves. Gardeners are able by these means to propagate from a single plant and to preserve characteristics such as variegation in the offspring. The various methods used include division, cuttings, layering, and grafting

#### DIVISION

Strictly, division is the separation of one plant into several self-supporting ones it utilizes the habit of many plants that produce a mass of closely knit shoots or buds, forming a clump, or crown, of growth. The clump can be split into sections, each with at least one shoot or bud and its own roots. This is quick and easy but yields only a few new plants

In temperate climates, division is often carried out when the plant starts into growth in spring. Water loss is minimized because of the lack of leaves and roots grow quickly to reestablish the division. In tropical areas, divide plants whenever convenient, always trim the leaf area to reduce moisture loss, and provide shade and adequate water.

Naturally dividing alpines, such as Campunila garganica, Raoulia australis, and Saxifraga paniculata (see below, left), and herbaceous plants with fibrous toots, such as Achillea, Aster (see below center), Phlox, and Stokesia, are simply pulled apart. Young crowns are easter to dear with than old, woody ones

Herbaceous plants with fleshy roots and buds, such as Astithe, hellebores, and hostas (see below, right), are rather more difficult to divide without damage. Semi-woody herbaceous plants are usually evergreen, these include Astelia, pampas grass (Cortaderia), Phormium, and Yucca filamentosa. They produce swordlike leaves from ground level, crowded in dense terminal clusters, each with its own roots. Clumps are split with a sharp border spade or mattock. Young plants are easier to tackle

A small number of woody shrubs and trees, including Acer circinatum, Aesculus parviflora, and Aronia x prunifolia, form clumps of growth from suckers below soil level, these can be removed to make new plants. Young parent plants may be lifted completely before dividing the clumps, but leave the central core intact

The term "division" is also widely used to refer to processes similar to true division, for instance the separation from a parent plant of offsets of bulbs or caeti, of orchid pseudobulbs, and of rooted suckers and rooted runners

#### CUTTINGS

Propagation from cuttings exploits the remarkable ability of a piece of plant tissue, from the stem, leaf, root, or bud to regenerate into a fully developed plant, with roots and shoots. In this regenerative process, roots arising from stem, leaf, or bud tissue are known as adventitious roots.

To produce these, a group of growth (meristematic) cells, usually close to the central core of vascular (sap-carrying) tissue, changes, becoming root initials (root cells), which form root buds and then adventitious roots. These are also called "induced" or "wound" roots

#### ADVENTITIOUS BUDS

A few mostly succurent plants, for example 1918 Kalanchue daigremontiana can reproduce regetatively by producing tiny piantlets, called adventitions buds, on the leaf margins. When fully formed, the plunttets drop to the ground and root outo the son These provide a YOM COSY MIGHTS of propagation

because, in most plants, they occur only after some type of wounding, such as cutting off a piece of bark

In some plants, such as tvy (Hedera), poplars (Populus), and many in the minifamily (rosemary and salvias), preformed root initials he dormant in stems, so they root rapidly and easily from cuttings. A few plants, such as Prunus Coli', even form root buds, normally visible at the bases of shoots. Other, often hardy, woody plants are difficult to root with these, callusing (see facing page) may hinder root formation, and it may be best to graft (see p 27)

#### PREPARING CUTTINGS

Most cuttings are taken from a plant stem, they may be severed between the leaf joints, or nodes, (internodal cutting) or just below a node (nodal cutting) Nodal cuttings expose the most vascular



NATURALLY DIVIDING ALPINE Prants such as this Saxdraga particulate produce new plantlets each year around the parent crown. Dividing the plant is a simple task. Lift the plant and gently pull the plantlets apart for replanting

good roots



FIBROUS-ROOTED HERBACEOUS PERENNIAL Champs with Jabrous roots there of Aster umbelianus) are easily pulled or cut apart into pieces that will establish quickly. Clean off the soil to reveal the natural lines of division



FLESHY-ROOTED HERBACEOUS PERENNIAL Plants such as this hosta have a compacted crown that is difficult to divide without damaging the pronounced, fleshy buds and roots. Pull it apart one pieces with at least one bud and good roots.

#### PREPARING CUTTINGS



NODAL CUTTING. The celes avolved in growth are most concentrated at the leaf joints ør nodes, sa most entrings are tranmed first below a node to opumize mot formation.



roots more readily if bark is cal-

away from the base of the stem-

class aposes mone of the growth

core it the torbidon fayer

Heel contains high levels of growth hormone and protects authorgragamst ret 1 m (2.5cm cart expreses



cuttings, especially of semiripe wood, are taken by pulling uway a small sideshoot so that it retains a "heel" of bank from the main shoot



CALLUSING When a stem is cut or wounded it forms callus tissue (see susci) over the damaged cells. in difficult-to-root plants, or if the soft mix is too acrated or alkaline (high pH), the catlaspad may thicken preventing not growth If this happens, pare away the excess with a scalpel

H ARDWOOD

Long lengths

of fully mature,

voting stems are

taken after leaf

fall and before

starts in spring

from decidaous

stiere of willow)

evergreens

ar broudeaved

woody plants

new growth

tissue, increasing the likelihood of root formation (see above). Other ways of encouraging rooting include wounding (see above), especially of woody plants, and the application of hormone rooting compound (see p 30). The growing tip may also be removed from a cutting to redistribute natural growth hormones. (auxins) to the rest of the stem for root and shoot growth

#### Types of cutting

Cuttings are taken from stems, leaves, or roots (see right). There are several types SOFTWOOD CUTTINGS. These are usually taken from the first flush of growth in spring. They have the highest rooting potential of stem cuttings but a low survival rate. They lose water and wilt quickly, as well as being vulnerable to bruising, which may expose the foliage and stem to attack from botrytts (rot) GREENWOOD CLTTINGS. The stems are still young but beginning to firm up They are easier to handle than softwood cuttings and not so prone to wilting STAIL-RIPE CUTTINGS. When stems are firmer and buds have developed, they are semi-ripe. Cuttings may be taken with a heel, especially from broadleaved evergreens and conifers HARDWOOD CLITTINGS. These are from dormant wood. They are slower to root

but robust and not prone to drying out LEAF-BI D CUTTINGS. Often taken from shrubs, these provide an economical way of using semi-ripe stems LEAF CUTTINGS A few plants can regenerate new plants from a detached eaf or section of leaf tissue. These include members of the families Begoniaceae (see p.190), Crassulaceae (see p 245), and Gesneriaceae (see p 207). It is possible to root leaves of plants such as Clematis, Hoya, and Mahonia, but they cannot produce buds so can never develop into complete plants. ROOT CUTTINGS A limited range of plants - ones that naturally produce shoots, or suckers, (continued on p 24)

#### TYPES OF CUTTING



SOFTWOOD These are taken from new shoot tips (stem-tip cuttings) or basal shoots (basalstem cuttings) most often a spring, when they are almose tully developed but still soft



SEMI-RIPE Once new growth has slowed and the shoots tas started to become firm which entry be from midsarrii er roan mor some operatings are taken from the stems

NEW MERCE

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of the other



WHOLE LEAF Some plants have dormant buds at the leaf bases These produce new piants when leaves are treated as cuttings



Philippe Brecoma

FORS IN THE R. P.

PART LEAF A few plants regenerate from leaf tissue. Take leaf sections or wound leaves at any time in the greating season

LEAF-BLD Semi-ripe cuttings with a short stem and one leaf can be taken from some plants to obtain moncurrings from one stem

ROOT Lengths of hearthy, strong root of pencil or medium thickness for the plant can be taken in the dormant season



New roots

Acanthus!

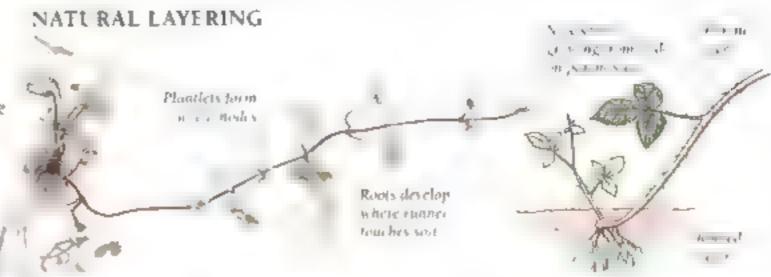
(continued from p.23) from the roots such as Acanthus molits (see p.158) and Rhus typhina — can be propagated from root cuttings (see p.23). Their roots are usually thick and fleshy, in order to store the food that allows the root to survive as it produces shoots.

#### Success with cuttings

The process of taking cuttings is relatively simple but success will depend on several factors. The inherent ability of the parent plant to produce adventitious roots will determine the degree of care needed to coax cuttings to root. Also, the condition of the parent influences the quality of the rooted cutting. Always choose a healthy plant diseases or pests can be transmitted to a cutting. Material taken from young plants, especially when in active growth, is usually more likely to root. Water the parent plant thoroughly a few hours beforehand so that the tissue is fully turgid, especially for leafy cuttings

Prepare and insert cuttings quickly to avoid losing moisture through transpiration. Hygiene is also essential to avoid introducing disease into a cutting through cuts or wounds. Keep surfaces and equipment clean (see p.3d). The cutting tools should be sterile and as sharp as possible to avoid crushing plant cells along the cut

In warm climates, cuttings of many plants may be rooted outdoors, directly



States WERING Some plants notorally reproduce by toxoring Plants with runners, such as gracial by Glechoma hederacea), produce plantlets along their runners that are nourished by the patter tuntil they root into the soil. Rooted stems are easily litted and devoked

Ttp LAYERING A few shrups and cloubers, notably brambles. Rubus) will most from the tips of their leng arching stems. Once the new sheet forms, the mosted tip can be detached.

inserted into prepared soil in shade at almost any time of year. In colder areas, a controlled environment is often vital, rooting may be unpredictable and slow 8 ottom heat of 39–77°F (15–25°C) can promote rooting. The air should be much cooler to avoid encouraging growth of foliage instead of roots. The rooting medium (see pp 32–5) should be moist at all times and the air humid especially with leafy cuttings. (See The Propagation Environment, pp 38–45.)

The time taken for a cutting to root depends upon the plant, the type of cutting, age of the stem, how it was prepared, and the rooting environment Leafy cuttings root in about three weeks, woody cuttings take up to five months

#### LAYERING

Some plants have a natural propensity to regenerate by self-layering – forming adventitious roots from the stems where they touch the soil (see above, left) Such plants include Campsis, Hydrangea anomala subspiperiolaris (see p.131), and try (Hedera). Some form new plants by tip layering (see above)

These tendencies are exploited in lavering, in which stems in active growth are induced to produce roots at the site of a wound (see top of facing page) while they are still attached to the parent plant. Once rooted, the stems, or lavers, are severed from the parent plant and grown on individually. Layering is a good way of creating a small number of

#### USING STOCK PLANTS FOR PROPAGATION

A stock plant is grown purely to provide cutting material. It can be encouraged to produce the best type of growth for cuttings while plants that are grown for garden display can be left untouched.

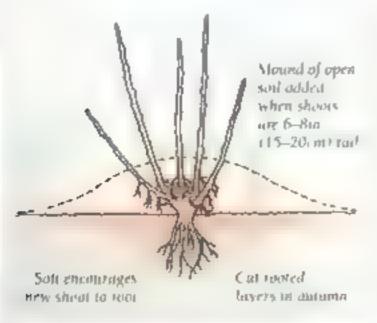
A stock plant should be healthy, mature, and vigorous with compact, bushy growth and lots of young shoots. It should be a good example of its type, for instance, it should flower and fruit well. Cuttings from such plants root more easily and give better results. Avoid diseased plants, especially those infected by virus, because diseases.

can be passed on to cuttings. The age of a stock plant can affect its ability to root. New plant introductions, especially ones selected from seedlings, often show vastly improved rooting capacity over older plants of the same species.

There are several ways of conditioning a stock plant to improve its regenerative ability high potassium levels and a pH appropriate to the plant in the growing medium, good light and a restricted root run ensure high energy reserves for root and shoot development in cutting material. Hard pruning will produce strong basal shoots for cuttings. Subjecting

the stock plant to 36°F (2°C) for two weeks followed by forcing at 46–59°F (8–15°C) induces new shoots with enhanced rooting ability this method sints certain deciduous plants such as some azaleas (Rhododendain), Clematis, and Ceratostignal Recping stems out of light for a time elongates the cell tissue whitens the stem, and softens the 5kin at clation), helping difficult plants to root

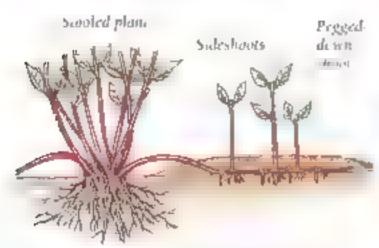
No more than 60 percent of the topgrowth should be taken from a stock plant at any one time. After taking the cutting material, allow the plant to grow back



TRADITIONAL
STOOLING A young
strong stock shrub is
out hard back in late
winter or early spring
and new shoots are
mounded with soil
(see left) to produce
rooted layers in the
autumn, all of which
are renteved. The base
(stool) will send up
new shoots next year



#### INDUCING LAYERING



FRENCH LAYERING In this form of stooting (see facing page), new shoots from the stool are pegged along the soil. Sideshoots are hilled. up at stages to a depth of bin (15cm). When these mot they are separated and grown on

new plants with relative certainty since the new plant is nourished by its parent until rooted, but it is space-consuming

Most layering involves pinning the stem to the ground, as in simple layering (see p. 106) and serpentine layering (see p. 107). With mounding (see p. 290), stooling (see box, facing page), and the more complex French layering (see above), layered stems are also etiolated by hilling up, then pruned. This builds up nutrients and growth hormones needed for rooting at specific sites on the stems

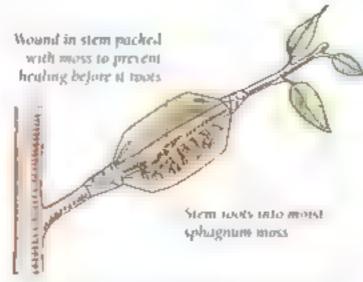
Air layering (see above) is used for stems that cannot be trained to reach soil level, instead, a rooting medium is packed around an aerial branch Air layering works because removing the bark of the stem traps food that would normally go to the roots, thereby providing nutrients for rooting at the site of the wound on the stem

#### STORAGE ORGANS

Some plants have natural food-storage organs that enable them to survive a period of dormancy until conditions are once again favorable for growth. They also provide energy for developing shoot systems during periods of growth. The storage organs may last for several years or be renewed annually. This natural vegetative process of regeneration can be exploited to produce many new plants. Many plants with storage organs. are collectively known as bulbous plants, but only some of these are true bulbs.

Bt LBS are compressed stems with a basal plate from which roots grow Each built contains a bud, with an embryonic shoot or a complete embryonic flower, which is enclosed by a series of fleshy eaves known as scales

In bulbs such as those of daffodils, tulips, and onions, these scales are closely packed, completely encircling those within and not readily separated, this type of bulb is described as nonscaly (see right). The bulb is enclosed in a papery covering, or tunic, that protects



AIR LAYERING This technique provides a way of layering an aerial shoot. The shoot is wounded with a shallow cut or by removing a ring of back to stimulate moting, and a plastic sleeve full of moss or said mux is taped around the stem

it from surface damage and drying out Others, such as fritillaries and blies, produce narrower, modified scale leaves that are not protected by a tunic, these are known as scaly bulbs (see below) and are more susceptible to drying out

Bulbs reproduce by producing offsets (see below) or sometimes bulblets and bulbils (see p 26). Detaching these and growing them on is the easiest and quickest means of propagating bulbs Plants with bulbs can be increased in larger numbers by various, albeit slower and sometimes challenging, methods

A bulb may be cut into segments, by chipping, or into pairs of scales, in twinscaling, each retaining a piece of basal. plate (see below and p 259). In sunable conditions, the chips or twin-scales can

#### WOUNDING A LAYERED STEM

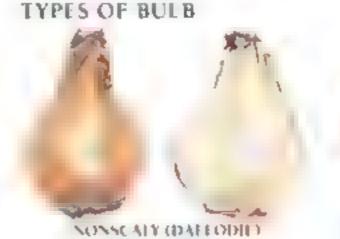




Wounding prompts a layered stem to root Do this by gently twisting the stem until the bark cracks (see above left), scraping off a little bark, or by making a sloping cor in a the stem to form a "tongue" (above right)

be induced to produce bulblets on their basal plates. Bulblets can then be grown on singly. When a scaly bulb is lifted from the ground, single scales may fall away and, if left in the soil, will form a new plant. In scaling (see below and p 258), the scale leaves are deliberately detached and induced to form bulblets as for chipping and twin-scaling.

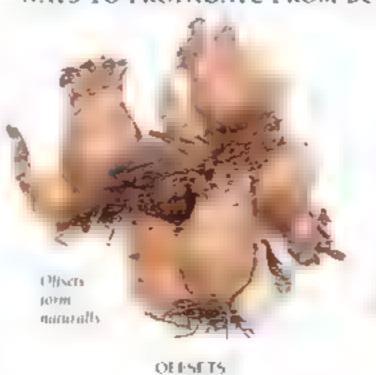
For hyacinths mainly, scooping (see p 270) and scoring (see below and p 270) are effective. They involve wounding the basal place callus tissue then forms, encouraging bulblets to develop. In scooping, the center of the basal plate is removed, leaving the outer edge intact When scoring a bulb, two shallow cuts are incised at right angles to each other into the basal plate (continued on p 26)







WAYS TO PROPAGATE FROM BUILBS

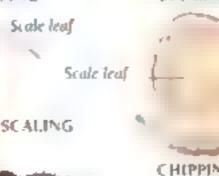




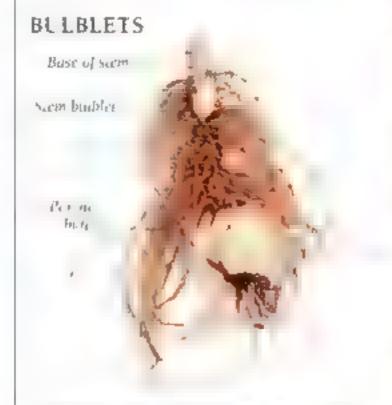


TWIN-SCALING SC ORING Scale leaf

SCALY (LILY)



CHIPPING



I sy belies son etalles toron i lear aty or the parent biab or on rooting stells orlow grand here on a ldy). These may be detached a dependent of a language bolis.

(Continued from p.25.) Some bulbous plants produce tiny bulbs (bulblets) or bulblike structures (bulbus), which in the wild root into the ground to form new plants (see above). These readily form new plants if detached

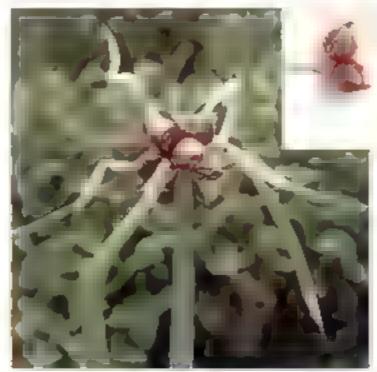
CORMS are formed from the thickened underground base of a stem, usually within some overlapping, papery, scale-like leaves (see below). One or more buds arise on the upper surface. In most cases, the corm is renewed every year, forming at the base of the current season's stem, on top of the old corm. Tiny corms (cormels) may form around the parent and can be used for propagation.

R uzomis are usually swollen underground stems, either thick, as in bearded trises, thin, wide-spreading, and fast-growing, as in wild rye (Elymus repens); or in a crown, as in asparagus. Ferns produce a variety of thizomatous structures (see p. 162). As a rhizome grows, it often develops segments, each with buds that break into growth when conditions are favorable. The segments are cut apart to propagate them (see below right). Some rhizomes, such as those of mint, look like fleshy roots, treat these as root cuttings (see p. 288).

ROOT IT BERS are swollen sections of root that are unable to form adventitious buds except at the crown (see facing page). Once the buds have produced shoots and the food storage is used up, the tubers die. New tubers form during the growing season. The plant can be increased by detaching a section of the crown with a bud.

STEM TI BERS are modified stems with the same function and life cycle as root tubers, but they possess more growth buds, over much of their surfaces. Many tubers may be produced by one plant, as in the potato (Solanum tuberosum) Tubers of perennials such as Anemone

#### BULBILS



IN A FLOWLEHLAD. Small had a some tares form in the flowerheads of some hidbs, such as this tree onion. The hulbils weigh the stem down to the soil, into which the hulbils root (see inset).

coronaria increase in size each growing season, producing leaf and flower shoots from the upper side and roots from either side, or both. To propagate stem tubers, take basal cuttings or cut into sections (see facing page)

PSELDOBELBS are found only in sympodial orchids such as Cymbidium I hey often resemble bulbs but are actually thickened stems arising from a rhizome. Pseudobulbs may be divided in various ways by cutting through the rhizome (see p. 179).

Other plants of orders of some plants, for example Saxifraga granulata and some kalanchoes, develop round bulblike buds at the shoot axils. These can be propagated as for bulblets or cormels (see above and below). In some aquatic plants, for example frogbit (Hydrocharts) and Hottonia, these buds are relatively large and are known as turions. When mature, the buds drop off the parent plant and in spring rise to the surface to develop into new plants. Other plants produce tubercles (see Jacing page)

#### CORM AND CORMELS



A corm has one or more buds at the apex, from which a new corm grows each year. I study, the old corm withers away. Tiny corms (corniels) may form between the old and new corm, they may be removed and grown on (see inset).

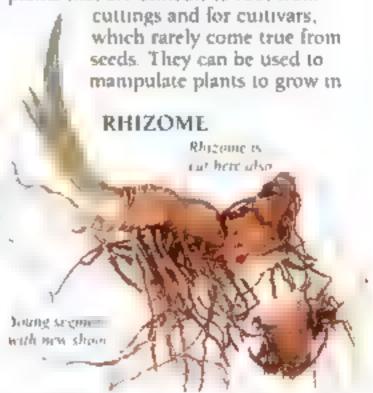


IN LEAF AXILS. Some plants there a hiv form hidbids in leaf axils. Morate half-is come away easily and can be grown like seeds (see inserfor more halfills, cut back (thes before However)

#### GRAFTING

Grafting and budding involve joining two separate plants so that they function as one, creating a strong, healthy plant that has only the best characteristics of its two parents. A root system is provided by one plant (the rootstock or stock) and the desired topgrowth by the other plant (the scion). Although the rootstock greatly influences the growth of the scion, both retain separate genetic identities, and there is no intermingling of cell tissue between the grafted parts. Shoots produced above and below the graft union will be characteristic of the rootstock or the scion, but not both

Grafting and budding are laborintensive, requiring skill in preparing the rootstock and scion and in caring for the graft to ensure that the parts unite. They are, however, useful ways of increase for woody and herbaceous plants that are difficult to root from



Khi omes are sometimes swollen stems that usually grow horizontally below or on the soil Mature rhizomes (here of iris) may be increased by cutting them into sections of young, healthy growth, each with at least one bud

# ROOT TUBER

R tot tubers are swonten sections of root near the stem base (here of Senecio). The buds are at the crown of the plant, which may be divided provided that each piece has a bud.

#### STEM TUBER



DORSTANT STEM TUBER Stem tubers (here a Cyclamen) have the same storage function as root tubers, but because they are most to distinct they produce more growth buas.



BASAL CLITING Or way of propagating stem tubers is to take basal cuttings there of Begonia? These each consist of a new shoot with a piece of tuber at the base.



ROOTED SECTION Many stem tube, some he can mo sever he well a shope, to at mo sever he cach with a bad. The ban should produce here roots and shoots

## PROPAGATING FROM TUBERCLES



Inhercles are small tuberlike structures that are actually fleshy, scaly rhizomes. They are most commonly produced below ground, as with Achimenes (see p. 186), but can also be formed from buds located in the leaf axils or in inflorescences toward the end of the growing season. They can be detached and grown on in the same way as bulbils (see facing page)

a certain way or to adapt to specific conditions. Grafted plants often mature faster than those raised from cuttings Rootstocks can confer disease- or pest-resistance or control the rate of scion growth, some produce dwarf or very vigorous fruit trees

Plants must be closely related if a strong union is to form and remain strong throughout the life of the plant those of the same species are normally compatible. Scion wood must be well-ripened and not pithy. As with cuttings, grafts should be prepared speedily so that the cut surfaces do not dry out. Use of strict hygiene and sharp knives are critical in preventing fungi and bacteria from contaminating the cut surfaces.

For the tissues to knit successfully, the cambium layers (see right) of scion and rootstock must be brought into firm contact. The cambium – a continuous, narrow band of thin-walled, regenerative cells just below the back or rind – grows to form a bridge, or union, between the two parts in days. This consists of waterand food-conducting tissue, allowing the scion to benefit from the sap flowing from the stock. Tissue growth at the graft is enhanced by warm temperatures

If the fibers of the rootstock and the scion fail to interlock, shoots may develop at the union. Corky tissue between the rootstock and scion may appear, making the union weak and prone to collapse at a later stage. Some rootstocks sucker from below the graft union, especially if roots are damaged. Ugly swellings at or near the union occur on trees if the growth rates of the scion and rootstock are very different

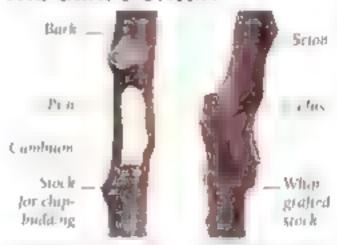
#### TYPES OF GRAFTING

In approach grafting, the scion grows on its own roots until the graft union is made it is rarely practiced today, except perhaps in the case of tomatoes (see p.303). Detached-scion grafting is used instead. This involves uniting a piece of the scion, the plant to be propagated, with the stock. The stock should be more advanced in growth than is the scion, ensuring that the union calluses well before the scion breaks into growth

In apical grafting, the top of the stock is removed and replaced by a scion, end to end. Popular apical grafts are spliced side, whip, whip-and-tongue, and apical wedge. In side grafting, such as a spliced side-vencer graft (see p.73), the scion is inserted without heading back the stock (See also pp.56-63 and pp.108-109.) Budding is also a side graft, using a single bud (see right), often used for roses (see p.114), fruit trees, and some ornamental trees and shrubs when scion material is limited. There are two types; chip-budding (see p.60) and I-budding (see p.62).

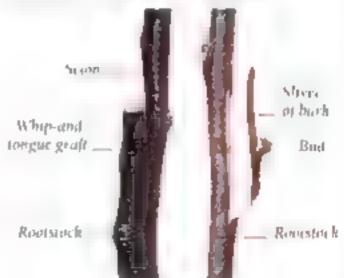
It is possible to graft three plants in line (double-working) to ensure root anchorage together with controlled vigor or to use the interstem (between the roots and the fruiting part of the tree) as a link between an incompatible rootstock and scion. Novelties such as weeping standards or multiple trees (see p.57) can be created by top-working

#### THE GRAFT UNION



ENPOSED CAMBIUM—CALLUSED UNION Success in grafting depends on matching the cambrious of both rootstock (see above left and scion. When in contact, these form a union between stock and scion and the wound scals uself with a corby layer or callus (above right).

#### BASIC TYPES OF GRAFT



In detached scion grafting, a prepared scion (shoot) is joined to the rootstock, which may or may not be cut back. In bidding, the scion takes the form of a single bud, the rootstock is cut back when the bud begins to shoot

# TOOLS AND EQUIPMENT

As well as general gardening tools. A such as spades, forks for lifting plants, and rakes for preparing seedbeds, there are certain items that are essential or useful in preparation of propagation material. For details on larger items, such as greenhouse equipment, cloches, and shading, that are used once plant material has been prepared, see The Propagation Environment (pp 38-45)

A small, but essential, item is the label always label propagated material to avoid confusion later. Note the name and include the date so you can judge when to expect growth. Many kinds, including plastic and copper (see below), are available. If storing seed packets in a refrigerator, use ballpoint pen on freezerbag labeas - it does not run

EQUIPMENT FOR SEEDS AND CUTTINGS Several items of equipment make sowing seeds or taking cuttings easier, such as

dedicated seed sowers for large numbers of seeds (see right) and seed trays, pots, and other containers (see p.30). Also very useful are

SIEVES When sorting and cleaning home-gathered seeds, choose a clean sieve (see below) of a mesh size appropriate to the size of the seeds When preparing soils or soil mixes, a metal or plastic soil sieve with #=\%in (3-12mm) mesh is suitable to remove coarse material or lumps. Use one with a finer mesh to sift a covering of soil mix over seeds

DISBLES AND WIDGERS. These looks (see bottom) are used for making holes in soil or soil mix for seeds or cuttings and for lifting new plants after rooting or germination Pencils, chopsticks, and old spoons also work well GARDEN LINE If sowing seeds in rows outdoors, use this (see bottom, right) as a guide to draw out the drills



HAND-HELD SOWER. This seed sower has adjustable settings for a fferent sized seeds it is leases them one by one so they can be space-sown and will not need thinning



WHEELED SOWER Use this seed sower to distribute seeds evenly along drills It has a long hande enabling the gardener to work without bending and macing task less riving

#### PLANT LABELS

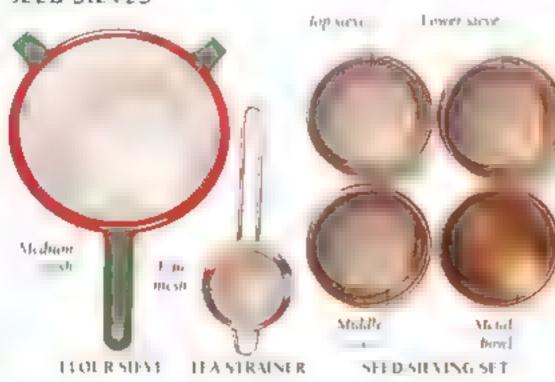


PLASTIC COPPLR

Plastic labels may be written an in pencil so are reusable but fade and become brattle over time Copper labels are permanent hat cannot be reused and are expensive. Black scratch labels are permanent but are plastic and less durabic

GARDEN LINE

#### SEED SIEVES



lefe) can be used to sieve seeds but most not their be used for culturary purposes Specialized seed sieves left) are used or Macks. The chaft collects in the top. coarse sieve and the seeds fall through to the middle or lower steve, depending on then size Dustloss shall sifes through the lower fine sieve int the metal bond

Rithfully as In-

#### DIBBLES AND WIDGERS

A dibble is a pencil shaped tool, with or without a handle used to make planting holes. I se a large Abble for sowing large seeds such as been, linear or for transplanting seedlings, especially those (such as leeks) that need a wide plantit - holi. A small dibbliis ideal for sowing seeds or inserting, arrows or corremers. Tray dibbles are fine for accurate space-sowing or for marking seconds of top-dibbling. Widgers allow lifting of seedlings and cuttings with a minimum of disturbance to their new roots



LARGE MEAST RING D'BBLE D' BBLE



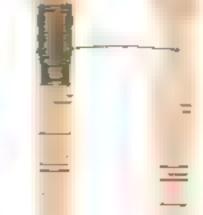
WIDGER WIDGER



1845 DIBBLE

SMALL

DIBBLE



When marking out drills, use this tool as a guide. Plange one stake one the soil and tottare the line to the required length Depth markings are scored into the stakes to keep the line level

#### KNIVES AND CUTTERS



For propagation, it is important to use knives appropriate to the plant pancrial and technique t se a garden krafe for standard cuttings but a scalpel for cutting



#### GRAFTING EQUIPMENT



RAFFIA

GRAFTING TAPE

Grafting tape, rathalloi rubber patches are used to hold together a graft. while it is "taking Scalants such as cord or hat grafting was protect exposed wood around the graft from disease or drying out



BUDDING PATCHIS

GRAFTING WAY

PLANTING BOARD A narrow board 10ft (3m) long and marked every 1m .2 5cm) allows you to stand on soil. without compacting it and provides a straight edge to draw out drills and

a rule to measure spacings Hor. Use a hor to make seed drills (see p.218) and to weed between plants KNIVES AND CUTTERS. A garden knife with a plastic or wooden handle is useful for taking and preparing cuttings (see above). Most have a carbon steel blade hat is fixed or folds into the hand e-Use snippers (see above) for very fine soft stems. Pruners are good for taking woody cuttings, the seissor type makes

a cleaner cut than anvil pruners Use a scalpel (see above) or fine-bladed craft knife for very small cuttings and for cutting very soft tissue, such as each All blades used for propaganon should be kept clean and very sharp DESICCANT Silica gel crystals are useful for keeping stored seeds dry and may be reused. Place a layer of gel at the bottom of a container, and the seeds in labeled paper packets on top. Powdered milk can also be effective but is not reusable PAINTERS Str. A small paintbrush with fine, soft bristles is useful for hand pollmating flowers in order to improve seed set or in hybridizing

GRAFTING EQUIPMENT

KNIVES A grafting knife (see above left) has a strong, straight blade and is ideal for making accurate cuts in woody stems. A budding knife (see above left) has a spatula on the reverse of the blade, which is used for prying open the bark around the incision when budding. For intricate seedling gralts, safety-razor blades are more precise

BINDING MATERIALS As well as plastic gralting tape and raffia (see above), wide rubber bands or latex budding tape are used to bind a graft umon until it calluses. BUDDING PATCHES Rubber patches (see above) are used to bind bud-grafts, especially of roses. The rubber rots away over two months as the union calluses. STALANTS For scaling grafts use wax which may be applied cold (see above). or hot, or wound paint

GENERAL PROPAGATION EQUIPMENT Other items that are particularly usefufor propagation include the potting box (see left), which can be portable or built into greenhouse staging, and watering cans. Use a plastic or galvanized metal watering can (see below) with a fine rose Begin watering seedlings and cuttings to the side (continued on p.30)

#### POTTING BOX



4 porting box, made from plastic or metal. provides a selfcontained area for assks that myoba ex soit mix, such ds transplanting seculings, sewing seeds, and pouring cuttings. The potting box is easily elemical and moved to a contenion spot

USING A WATERING CAN

Eme brass rose

here of resemary) This civates a line mset) give a finer spray than plastu

#### THE IMPORTANCE OF HYGIENE

When propagating plants, it is essential to maintain high standards of hygiene to prevent any possibility of pests and diseases being transmitted through contamination. Sterilize tools and equipment before use, particularly blades of knives and pruners, either by heating them (see right) or wiping them in alcohol between each cut it also helps to wear gloves (see below) or wash hands regularly and keep work surfaces clean, especially when wounding plant material

Ideally, use new containers or sterile preformed units such as rockwool plugs of compressed peat pellets (see p.35). Pots and other containers should always be scrubbed and steriff ed (see far right).

LATEX GLOVES These are close-fitting, with a more sensitive touch than gardening gloves, and stende, so are ideal for use when preparing plant material such as cuttings or bulb sections. The gloves also protect against irritant sap



STERILIZING TOOLS Keep kmfe, scalpel or pruner blades sterile by heat treating them. Dip a blade in alcohol and quickly pass if through a candle flavor. Do not recontaminate the blade by touching it or wiping off any soot.



CLEANING CONTAINERS Dirty containers can harbor diseases and minute pests. Wear protective gloves and thoroughly scrub each pot with a stiff brush in ditute household distributeant. Rinse and allow to dry before use

(continued from p 29) of the container, then move the spray over it to avoid drips disturbing the soil mix. A greenhouse watering can may have a long spout to reach the back of a bench

MIST SPRAYERS. These may be handheld or pump-action and are useful for misting young plants that need a humid atmosphere. The nozzle can be adjusted to produce a line spray.

PRESSER OR TAMPER. Square or round. wooden presses (see top of facing page). are easy to make and are useful for firming soil mix in pots. A firming board slightly smaller than a seed tray is also handy. You could also use an empty container of the same shape and size SHARPENING STONE Use this to keep blades of knives and pruners (see p 29) sharp. Always do this yourself, because everyone holds the knife at a different angle. A sharp blade will not crush the cells of the plant tissue along the cut, so there is less opportunity for disease to enter propagating material, improving the chances of success

Fundation Before taking cuttings, apply a commercial fungicide to the parent plant to avoid contamination. Also dipprepared cuttings in a dirute fungicidal solution and dust cut surfaces, such as on fleshy roots or bulbs and tubers

#### HORMONE ROOTING COMPOUND

This preparation contains synthetic hormones similar to those that occur naturally in plants and is used to encourage root growth, for example in cuttings and layered stems. It may also contain a lungicide to protect against rot. The compound is available in powder, gel, or liquid form. Gel adheres to a stem or wound better than powder and is less likely to coat the stem too thickly or to be wiped off as cuttings are inserted. These are generally available in

three strengths, no 1, the weakest is for softwood, no 2, of moderate strength, is for semi-ripe wood, and no 3, the strongest, is for hardwood – but often they are multipurpose

When using hormone rooting compound, tip a small amount onto a lid or container and discard any unused compound when you are finished, so that the rest of the compound does not become contaminated. With powder, knock off any excess, too thick a layer may inhibit rooting. The compound lasts about a year in a refrigerator

#### CONTAINERS

A wide range of containers, including the traditional pot and seed tray, are now available (see below). Plastic pots

are more hygienic, lighter, and cheaper for propagation purposes than clay, or terracotta, pois. Plastic pots retain more moisture, but clay pois provide better aeration and drainage. Square pots take up less space and make more efficient use of bottom heat than round ones STANDARD AND HALF POTS. Standard pots. are as deep as they are broad. Half pots are one-hall to two-thirds the depth of a standard pot. The pots are useful for small quantities of seeds or cuttings. and for growing on young plants. FUNDER PLANTIC POUS AND SOFT PLANTIC POTS. These are cheaper than rigid pots but are used only once and then discarded. They are good for raising summer bedding plants or vegetables and for growing on young plants

Deep porc POTS FOR PROPAGATION Clong toms colaid piets in Seed and es 7. 12+125 clas e prastic Floable Tube pots plastic pers Buildegradable poty Kad Hamilto Es Hale pera Pot saucres Plastic bags

#### PRESSER



Pressers are very useful for firming sort or x in containers. A small wooden presser with a honale is easily made to the extension of the term the sort mix by pressing genter and extension

PANS. These are one-third the depth of a standard pot (see below) so are good for shaltow-rooting material that might rot in too great a depth of soil mix. Used for seeds, small cuttings, and bulbs DEEP POTS (LONG TOMS). These are used for direct sowing or transplanting deep rooted plants, such as some trees and legumes, to avoid restricting the roots They are also good for plants with long taproots, such as eyeads, and other plants that might suffer a check in growth if the roots are disturbed ROOT-TRAINERS Each plastic pack of individual cells is hinged to allow root halls to be removed without disturbance The sides are grooved vertically to train root growth. They are mainly used for deep-rooted trees and shrubs fuat pors. Also known as sweet peatubes, these are made of plastic or cardboard and can be planted out without disturbing the plant roots BIODEGRADABLE POTS. These come singly or in strips and are usually made from compressed peat and other libers. The roots grow through the pots into the soil when planted out. They are good for vegetables and summer bedding plants POT SALCERS, Saucers may be used for vegetable seeds, such as sprouts SEED TRAYS Standard or half seed trays (see above, right) may be used for sowing seeds, transplanting seedlings and rooting small cuttings SEED TRAY INSERTS. These allow strips or plugs of soil mix to be held in a seed tray (see above, right) to save space and avoid a stage of transplanting. Rigid inserts last longer than flexible ones DRIP TRAYS Drip trays (see above right) lined with capillary matting make watering easter. The matting holds a reservoir of moisture that is taken up into the soil mix as needed CELL TRAYS Cell or module trays in a range of sizes (see right) are now

available for raising "plug" plants that

are easy to transplant. Care is needed in

watering, because they dry out quickly

#### TRAYS AND INSERTS

Prip tray with Seed Hall seed Rigid

Elevible modulus insen

As well as standard seed at a second section seed at seeds and cuttings. Strip and cell travs allow seedlings and soted ciatings to be ported without much rich branchable plastic fit into a standard seed tray and as a train forms. Drip a sea containers to be watered from bely w

SEN-CELL TRAV

This is the smallest

#### CELL TRAYS

Cell trays have been used commercially for a number of years and are now walchy available to the amateur. The cells allow seedings or cuttings as develop social root systems before hing ported up and to be bandled without distinbing the roots or harming the stems. Fill a tray with soutless seed now and som

seeds singly the the constant of the standard of the constant of the constant

practical size of cell

Lise this size to grow up a

576 small, fast geromating
seedings

COSTELL BRAN

This tray allows up t

several pairs of

1000

273 seedlings to develop

LAIS-CELL TRAY

Ly to 135 secdings may
be great as ab story

Por planticis into

LAIS-CELL TRAY
The larger trays hold up
to 70 seedongs in small
berbaccous cutaings

ROCKWOOL TRAN
fravs of rockwoon
plugs can be used, but
reed seedlings or care i go
with a dilate liquid
tertilizer once they
develop true leaves



# Soils and growing media

An appropriate growing medium is A crucial to success in propagation Soil beds outdoors are often used for growing on divisions and woody cuttings and direct sowing of seeds, especially of vegetables and annuals, but most methods involve soil mixes and merimedia under cover to provide ideal conditions free from diseases and pests Any propagation medium must be moisture-retentive but also porous to keep it aerated. It must be sufficiently free-draining so that the medium does not become waterlogged but not so much that the medium dries out

#### Soils

A healthy soil is vital for successful plant propagation. Soils consist of tiny particles of various weathered rocks and organic matter. Very fine particles impede drainage, so the soil becomes waterlogged and low in oxygen, large particles allow free drainage and air to reach roots but dry out quickly. The best soil has a mix of particle sizes. Fertile soil also includes trace minerals - such as boron, copper, Iron, manganese, and zinc - needed for healthy growth. Loam

#### SINGLE-DIGGING



Dig a trench 12in (30cm six a and a species blade deep. Dig a second trench placing the soil into the first. Continue, filling the fast.

our less both, sent more the first

#### STALE SEEDBED TECHNIQUE



1 This technique Lacips des roy PERMITTED AND IN possible before sowing seeds in a seedbed Dig the soil ligads to distinct a type of seeds on the soil (see right of bed)



• The weed seeds will gerri nate. on the cuttivated g eclosor a few ar his see right of had clear trem by right hacing or with a weedhate), without distracting the soo.

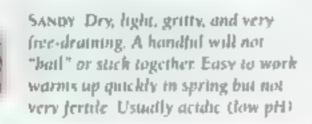
soils have an ideal particle mix, with 8-25 percent clay, giving good drainage and water retention and high fertility Soil is classified by its clay, silt, and sand content (see chart below), to identify a soil, rub a small amount of moist soil between your fingers. Soil preparation to achieve the ideal texture, fertility, and dramage for propagation is worthwhile

The acidity of the soil should also be considered. This is determined by its pH level, on a scale of 1-14 To test your soil, use a commercial kit. A ph below 7 indicates acidic soil, if the soil has a pH over 7, it is alkaline Regardless of the mature plant's preferred pH requirement, a low pH is best for cuttings, because any higher than 6.5 induces "hard" callus tissue to form and hinder root development (see also p 23) Maintaining a pH of 4 5-5 also helps prevent damping off (see p 46), Sullur will increase acidity of alkaline soils

#### BASIC SOIL TYPES AND HOW TO PREPARE THEM

SUIL TYPE

SOIL CHARACTERISTICS





ALKALINE Pale, shallow stony, free draming, and low fertility. "Chalky with pH of 7 or higher May be deficient in minerals such as boron. manganese, and phosphorus



PEATY Dark, crumbly, and rich in organic matter, Retains moisture well but can be too wet. Acidic (pH below 7) May lack phosphorus and contain too much manganese or aluminum



Shiff Silky or soupy to the touch with fine particles and a low amoust of clay Reasonably fertile and new stare retentive but compacts easily, especially when dry



CLAY Wet, sticky, heavy, and slow draining Ralls into malleable ball if pressed and goes shiny if smoothed Usually very fertile. Slow to warm up. in spring, bakes hard in hot weather.

#### PREPARING THE SOU

Improve loose structure with small amounts of clay. Water and feed often. Add organic matter to hold noisture Water-retentive crystals are useful on a small scale

Hongry" soil that breaks down organic matter quickly, diess seed and nursery beds often with organic man a probably acute vaca ds back or well-natural at assure

Makes excellent soil if limed drained, and fertilized. Add lime or mushroom compost to achieve best pH of 5.8. Add grit to improve drainage for seed and nursery beds

Encourage crumbly structure by adding some clay or adding plenty of bulky organic matter ideal soil for propagation use, especially for early sowings

Add lime to encourage fine particles to clump together, lay drainage channels of coarse sand or gravel Add plenty of bulky organic matter and grit to open up soil texture

#### OUTDOOR BEDS

Special outdoor beds offer the best way to provide ideal conditions for seeds and for rooting new plants. Digging helps acrate the soil and break up compacted areas, as well as allowing organic matter and fertilizers to be added if necessary For propagation, the important nutrients are potassium (for root growth) and nitrogen (for leaf and stem growth), phosphorus (for flowers and fruits) benefits established plants. Digging wet soil will cause compaction. Forking is less harmful to soil structure, it breaks up soil along existing natural lines

Seeds require a fine "ulth" - level moisture retentive surface soil that consists of small, even particles. This ensures good contact between seeds and soil so that moisture can be absorbed for germination. Choose a sheltered site: if needed, erect a windbreak or shading

About one month before sowing, single-dig the hed as shown (see above, left) Pile the soil from the first trench to one side and replace it in the last trench Allow the bed to weather and break up naturally. Just before sowing, break up any remaining lumps with a rake, then level the ground by treading gently

#### STERILIZING GARDEN SOIL

If you are planning to use garden soil in homemade soil mixes, it must first be sterilized to kill off harmful organisms that could adversely affect cuttings or seedlings during propagation To do this the soil must be sieved to remove stones and lumps, then heated to a nempennin temperature echer in a conventional even of in vibilitioways (see right). It is also possible to obtain special soil steribzing units, but these are expensive



IN THE OVEN Sieve moist soil through a bin (5mm sieve. Place a layer up to 3m (8cm) deep in a baking tray Bake for 30 manates at 400°F (200°C)



IN A MICBOWAYE OVEN Sieve moist soil and place in a masting bag. Seal it to stop soft from contaminating the oven Proce the bag heat on full power for ten minutes

because they are used in high-humidity

medium typically contains equal parts

of sand and peat (or peat substitute) It may also be based on bark or perlite or

a high proportion of coarse sand (river

sand). Since these mixes are low in

environments. A standard rooting

a slow-release fertilizer. If not, the cuttings will need feeding once rooted, alternatively, for cuttings that will be inthe pot for some time, such as those of woody plants, add a little fertilizer to the bottom of the pot so that the new roots are not scorched Basic soil Mix. This is not often used at

nutrients, they may or may not contain

the propagation stage, except in the case of woody plants or root cuttings. Such mixes may be soilless or soil-based, both types are free-draining. The soil-based potting mixes provide a steady supply of nutrients to the propagated material Soilless types are moisture-retentive and well aerated but quickly lose nutrients so are suitable only for short-term use such as growing on seedlings and sowing large seeds

SPECIALIZED SOIL MIXES Commercial mixes formulated for the special growing needs of particular plant groups are also available. These include orchid mix often based on porous bark for high aeration and open drainage, alpine and cactus soil mixes, which are gritty and very free-draining (continued on p.34).

Rake the surface with progressively finer rakes in different directions to obtain a fine tilth. Stale seedbeds (see facing page) avoid problems with weeds

Sometimes fertilizers are also needed to improve the soil's fertility Add leaf mold for seeds or cuttings of woody plants, it contains mycorrhizae, tiny fungi that benefit root and shoot growth Before sowing in cold climates, the soil may be warmed by covering it with plastic sheeting. Hardier plants need a minimum soil temperature of 50°f (10°C), tender piants prefer a minimum of 59°F (15°C)

Nursery beds are prepared in much the same way as seedbeds but do not need such a fine surface tilth

Raised or deep beds avoid the need to walk on and compact the soil and are free-draining, providing a useful option for gardens with heavy soils. They are especially effective for vegetables (sec p 283) or long-term propagation

#### COMMON INGREDIENTS FOR SOIL MIXES



Soit. High quality sterilized garden soil with good nutrient supply, drainage, aeration, and moisture retention. For substantial, soft based mixes.



GRIT Used on cay for right) or frac (left) for a cogrades. Substant-ally improves dramage especially for alpine and cactus mixes



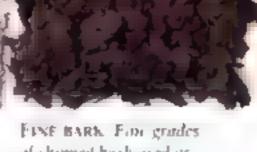
PEAT Stable long lasting well aerated and its istare recentive but low or autrients. Hard to rewet once dry for frentweight, short-term mixes

#### SOIL MIXES

When propagating plants under cover soil mix is usually preferred to soil because it is relatively free from pests and diseases and is light and wellaerated. Like the best soil (see factive page), it should have a mix of particle sizes and be acidic. There is a wide range of commercial soil mixes available

for use in propagation SEED SOIL MIX Specifically made seed soil mix is moisture-retentive finetextured, and low in nutrients (because mineral salts can harm seedlings). Seed soil mix frequently contains sterilized soil, peat or peat substitute, and sand or it may be soilless (without garden soil) The texture allows good contact between fine seeds and the moist soil mix, aiding germination

RECEIVED MEDICAL Mixes intended for rooting cuttings need to be free-draining PERLITE Expanded volume rock granules. Sterile inert and light retains moisture but drains freely. Mediani/coarse. grades and acration/dramage



of chipped back used as peat substitute or for very hee draining, acidic mixes, especially for on hids or palms.



VERMICULITE Expanded and air blown anca. Acts similarly to perlite but holds more water and less air Fine grade aids drainage and acon in



COIR Fiber from coconut husks, used as peat substitute Dries out less quickly than peat but needs more feeding Good base for souless mixes.



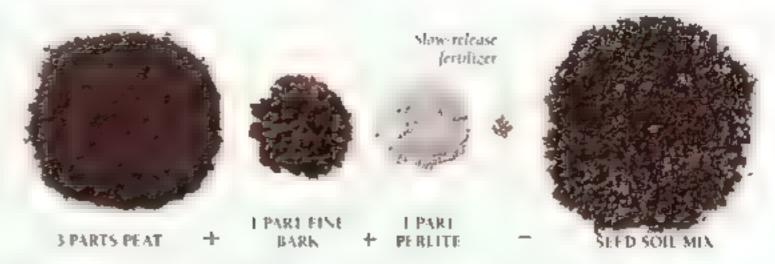
SAND Fine sand (left) helps dramage and aeration in seed soil mixes, coarse sand (right) gives more open texture to rooting media



LEAF MOLD Well-rotted sieved leaves. May harbor pests or disease. Course recture best in moting media or potting mixes

#### MAKING SOIL MIX

Some useful soil-mix recipes for use in general propagation are listed below Recommendations for soil mixes are generally expressed in parts, indicating the relative proportions by volume of each ingredient. Parts may also be expressed as a formula, for example 3.1.1. Here (see right) a seed soil mix is made up from peat (or peat substitute), fine bark, and pertite with a pinch of slow-release fertilizer.



SOIL-BASED SEED MIN

2 parts sor

I part peat (or peat substitute)

Dart Same

To each 8 gadons (36 liters), add 1%oz (42g) superphosfate and ‰z (21g) ground limestone

For an ericaceous (acidic) mix, use an acidic soil and omit the limestone

Sources such Mix
3 parts pear (or pear substitute)
1 part fine back
1 part perlite
10 each 8 gallons (36 liters)
add 1 Aoz (36g) of slow-release
left) (zer and 1 Aoz (36g) of
colomitic himestone

Solutess ROOTING MEDIA

I part peat (or peat substitute)
I part sand (or perlite or
vernicus te

CH

I part peat
I part back (%-200/3-1 mm
particle size)
To each 8 gallons (36 liters),
add 1 oz + 36g) of slow-release
fertilizer

1,100

I part peat
I part back (%=%in/3=15mm
particle size)
I part perhte
To each 8 gallons (36 liters)
add 1 = c = 36g) of slow-release
fertilizer

#### SOIL-BASED POTTING NOV

7 parts soil
3 parts peat (or peat substitute)
2 parts said

To each 8 gallons (36 liters), add 4oz (113g) of general purpose fertilizer and 3oz (21g) ground binesione

For richer mixes, double or if ple-he-quarteries of fortouer and limestene

For an encaceous (acidic)
max ascan acidic soil and omit
the linestone

A suitable formula for ferbitzer to be mixed at home is 2 parts bonemeal 2 parts superphodate 1 part potassium sulfate parts by weight)

SORGESS POTTING MIX

3 parts peat (or peat substitute)
1 part sand (or perhie)
1c each 8 gallons 36 oters) addition (14g) ammonium intrate
1oz (28g) potassium nitrate
2oz (56g) superphosfate
3oz (85g) ground limestone
3oz (85g) dolomnic limestone

- (14g) prepared horticultural

For an ericaceous (acidic) mix-onut the limestone

In all Jornalas, parts are by volume unless otherwise stated

(continued from p 33) but low in numerits, or aquatic soil mix, based on soil for anchorage but low in nutrients to avoid excessive algal growth

#### MAKING YOUR OWN SOIL MIXES

You can make your own soil mixes to obtain the ideal medium for individual plants. Propagation mixes can be made up from various ingredients (see p.33) Most mixes are based on soil, peat, or peat substitutes, combined with other ingredients that have different properties. Inert substances such as perlite, vermiculate, and rockwool fiber (see facing page) are useful, since each has been processed in extremely high temperatures and is therefore sterile. Perlite also does not compact easily, so it retains air but not water.

Peat is highly acidic and therefore is suitably sterile. Peat substitutes, such as coir (coconut fiber), pine bark, animal waste products, or straw, have been composted and heat-treated. Washed and graded horticultural sands and grits are also safe. Leaf mold is not sterile so is best for potting mixes. Organic materials such as ground crab shells promote microorganisms that combat damping off (see p.46) so may be added as a biological control. For long term propagation, add slow-release fertilizers.

When mixing composts, strict hygiene should be observed to avoid contamination with bacteria and minute pests. Tools, work surfaces, and soil-mix bins should always be kept clean and rendered sterile (see p 30) before each new batch of soil mix is made. If the mix is not used immediately, it should be stored in sealed plastic bags to avoid the risk of cross-contamination.

#### MAINTAINING SOIL-MIX QUALITY

ideally, 25–30 percent of the growing medium should consist of air Excessive compaction of soil mix causes poor air penetration, waterlogging at the base of the container and very low levels of oxygen. This results in the rotting of water-soaked bases of cuttings or death of root hairs and root tips of seedlings. When using mixes, care must be taken to firm appropriately (see right)

It is also difficult to keep mixes aerated because of natural compaction through watering and decomposition of organic matter. This can be prevented by using 3in (8cm) or more deep, well-drained containers (see pp 30–31) and placing them on a drained base, such as sand or pea gravel, where excess water may accumulate. The extra volume of mix acts as a buffer zone, compensating for overwatering by keeping the bases of cuttings clear of any wet zone at the bottom of the container.

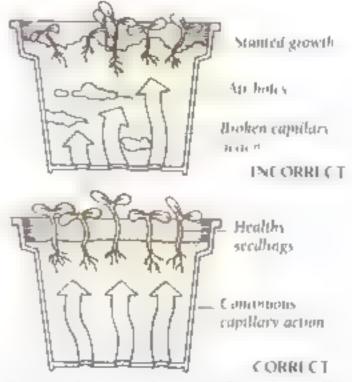
Do not use a very fine sieve for seed soil mix, since it may cause a crust to

form (capping), which hinders seedling growth. Sieve mix through your fingers or a coarse sieve.

#### COMPRESSED PEAT BLOCKS

These small, biodegradable blocks of peat, enclosed by a fine mesh, contain a special fertilizer. Once soaked in water, they swell to form individual planting.

#### FIRMING SOIL MIX



Water is drawn up through soil mix by capillary action, but air pockets interfere with the water columns essential for capillary rise. Lightly firm soilless mixes, especially at the edges of a container. Soil based mixes can be firmed slightly more than soilless mixtures.

COMPRESSED PEAT BLOCKS
These more than double in size
when soaked in a tray of water for
10-20 minutes. A plastic mesh holds the peat
together. Once wetted, a seed or cutting can be
inserted into the hollow at the top of each block

units (see above) Make sure that the blocks do not dry out, and when the new roots begin to show through the mesh, treat as rockwool plugs (see below)

#### INERT GROWING MEDIA

There are a number of stemle, inert media now available to gardeners, all of which avoid the problem of harboring diseases or pests associated with soils and soil mixes. Pure sands, grits, and rockwool also discourage the pathogens that cause damping off. Propagating with inert media utilizes the principle of hydroculture, literally "growing in water." Seeds or cuttings have access to an unlimited supply of water and of

#### WATER-RETENTIVE GEL

8i FORF SOAKING

AFTER SOAKING

This gel is commonly used in container soil mixes to conserve water. The dry crystals absorb water, increasing in volume to form a granular jelly. Some cuttings can be rooted in the gel

nutrients, which are added directly to the water in the form of liquid fertilizer. There is also unlimited oxygen, because the plant roots are in almost direct contact with the air. Some of the inert media in use today include rockwool, clay granules, florist's foam, perlite, gel, sand, pumice, and grit.

#### ROCKWOOL

This material is made from fibers spun from molten mineral rock. Its porous structure provides the precise water air ratio needed for healthy growth of seeds and cuttings. Do not confuse it with the water-repellent rockwool that is used for construction. Rockwool comes in different forms (see below): fibers may be used for aeration in soil mixes or in trays for root cuttings (see p. 158); loose fibers are best for slow-rooting cuttings to increase aeration. Insert seeds or cuttings singly in preformed plugs.

To use plugs, soak them first in tepid water for 20–60 minutes, after which they will have absorbed a good deal of water. Drain thoroughly – never let rockwool stand in water, because it will

#### FLORIST'S FOAM



Because of its water-retentive capacity and light, open texture, florist's foam is used to now cuttings of some plants, such as fuchsias. It is available in block or round form become waterlogged, reducing aeration Insert one or two seeds (see also p.222) or a cutting in each plug. Monitor water levels daily to ensure the rockwool does not dry out. To check a plug, gently squeeze one corner. If water comes to the surface, then no more moisture is required, otherwise, stand it in tepid water, for a few minutes only, and allow to drain.

As soon as roots appear, seedlings or cuttings should be transplanted, each with its rockwool cube, into soil mix to grow on, thereby avoiding disturbing the roots. Alternatively, the plugs may be inserted in larger planting blocks and grown on, and fed with liquid fertilizer, before planting out. Plugs should be well covered by the soil or soil mix so that they do not act as wicks and dry out the roots. In soil or soil mix, rockwool disintegrates over time.

#### OTHER INERT MEDIA

Florist's foam (see left) may be used like rockwool, especially for easily rooted herbaceous cuttings. Cuttings may be rooted in granular media as in rooting medium, but nutrients need to be added in the form of liquid fertilizer. A mixture of two parts medium-grade perlite to one part fine-grade vermiculate is less costly than rockwool, although results are not always as good. Sand, clay pellets, and grits are cleaner than soil and give better acration and drainage.

Water-retentive gel (see left) can be used for rooting woody cuttings, such as yew (Twats), add a liquid fertilizer to the water used to hydrate the crystals, insert the cuttings, and keep in a scaled container until they root. Easily rooted herbaceous cuttings root even in water (see p.156)

#### PROPAGATING WITH ROCKWOOL



LOOSE FIBERS



LOOSE GREENMIN

There are various forms of rockwool Loose fibers enhance acration in soil mixes, greenmixes blend of water retentive and resistant fibers makes a good peat substitute. Plugs are good for cuttings and seeds, once rooted, they can be "potted on" into planting blocks Hormone rooting gel and liquid fertilizer can improve results.



HORMONE ROUTING GLL



HYDROCULTURE



Cuttings or seedlings started in meri, sterile media, such as this Anthemis cutting rooted in water-retentive gel, are usually potted on into soil mix. In hydroculture, the new plants are potted on into other merit media, such as clay granules (see inset). A liquid fertinger added to a water reservoir supplies nutrients.



PLUGS, OR "CUBES"

# PROPAGATION IN DIFFERENT CLIMATES

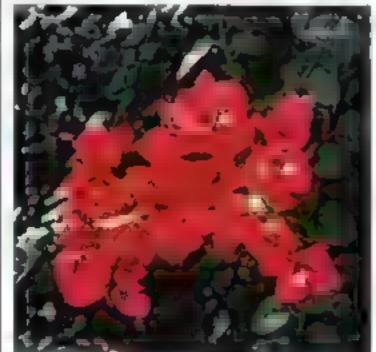
Propagation, and gardening generally is easier if plants are suited to the climate and can be grown outdoors all year round. Plants that are grown outside their natural habitats generally require artificially enhanced conditions under cover, such as heat and humidity for propagation. Some plants simply refuse to thrive in unsuitable climates for example, high-altitude species may not survive at lower levels with warmer conditions, and cool-temperate plants are not suited to the tropics.

Chimate has an important influence on propagation methods and types of material used. For example, in some regions, a shrub is best rooted from cuttings, while in other chimates it is better to layer it (see bilberry, right) in warm regions, much propagation is carried out in open ground, but in cool chimates the same plants must be raised under cover (see Bongainvillea below)

indeed, in warm zones many plants including various cool-climate subjects increase so successfully that they have become noxious weeds, in some areas of Australia Ailanthus altissima. Lantana camara, Tradescantia fluminensis, and some Opantia (see facing page) are weeds

Climate also affects the timing of propagation. In warm regions, suitable seasons may be advanced or extended beyond those advised in this book, while in cold climates with long winters and late springs, the gardener may need to delay propagation such as outdoor seed sowing. If the growing season is short propagation needs to be accelerated or the season must be extended artificially

In choosing the best method, season and plant material for propagation, it is therefore vital to consider the local climate and the conditions required by



BOUGAINVILLEA 'SCARLET LADY'
In humid equatorial regions, hardwood cuttings
of Bougainvillea root speedity in open ground
but in temperate climates, soft- or greenwood
brel cuttings need more care and still root slowly



In the wird, the hitherry (Vacciniam) my rtill, so is a pative of shady, damp woodland in climates that have long hot summers, they can he successfully grown from braidwood eatings because the new shoots will be fully intuitional by the aution a lin cooler regions, however better results in it be had from layering

BII BI RRY

each method as described in the A-Z entries of each chapter. It may then be necessary to take steps to improve the conditions for propagation (see The Propagation Environment, pp. 38–45).

#### **EXTREME CLIMATES**

Extreme climates have a narrow range of natural vegetation that is frequently modified for survival. For example, and and semi-and regions are home to many drought-tolerant plants, typically many succulents in Mexican deserts and dry area acacias in Australia. Spiny shrubs, annuals, and grasses predominate in and regions, bulbous plants in cold deserts

All propagation can be done outdoors during the long, warm seasons in and and semi-and climates, but shade and wind structures are essential as is water conservation. Propagation is still often easter in containers rather than in the open ground, which may also be low in nutrients. It is best to stick to plants that are adapted, cuttings of plants such as succulents should root readily and seeds germinate freely, given adequate water

At the other extreme are high-altitude and subpolar climates, which are very cold. In the Himalayas, rhododendrons are the main high-altitude plants, while mountains around the globe give rise to a diverse range of alpine plants. These include dwarf and prostrate perennials and shrubs and dwarf bulbous plants. Subpolar plants are also low-growing many are in the heath family. Encaceae including dwarf rhododendrons.

Again for propagation, it is best to choose native plants that, for example need cool conditions to germinate their seeds. The short growing season may need to be extended by artificial means. Outdoor propagation is generally out of the question in winter, under cover, it demands artificial heat and, in subpolar regions, extra lighting. New plants need

protection from severe cold, such as a well-insulated, frost-free greenhouse and are best planted out in spring

COOL AND MILD TEMPERATE ZONES

Maritime and continental climates in cool temperate zones are noted for their wide range of hardy trees, conifers, and perennials. Generally ideal for plant growth, a vast range of plants from all over the world can be grown. Winter cold and frost governs propagation. In maritime areas, spring often starts early

#### TYPES OF CLIMATE

Ann Very bot dry desert with cold seasons unpredictable and sparse rainfall Simi-and Edges of true deserts (semi desert). Hot but not so extreme as and with more vegetation and rainfall. He mid lot Atomia. Hot wet and humid all year round. Very high rainfall tropical in absonit seasons.

ID JUSCO P. SCASCUS SEASONAL TROPICAL Summers hot, wet and humid, winters warm and dry HUMID Subtropical and warm temperate chmates with rainfall all year especially in summer when hot or warm, causing h mudity Winters fulld, sometimes cold MEDITURANEAN Warm temperate climate Hot or warm summers with little or no rain Cool, wet winters. Drought-prone MARITIME In cool to mi dichinates, welwinds, with year-round minfall and cloudy dult weather. Mild springs and autumns. Winter frosts in cool climates COOL CONTINENTAL Cool temperate areas Winters long and cold-some imes severe cold and snow. Warm, short springs summers long, warm, or very hot autumns short. Raipfall all year often in summer. HIGH ALTITUDE Short summers, long, cold winters with heavy snow. Permanent snow at very high altitudes. High light intensity SUBPOUAR AND ICE CAP. Subpolar climates have short summers, long, snowy winters low light intensity. Ice cap has permanent snow and ice



#### OP, NIB

Comate affects the way in which this plant is given. In cold climates, it is a popular housepiant in and North Africa, the prickly pear is widely used as a hedging plant and fruit crop, but of Australia, at has become a permicious weed

so propagation times, particularly for outdoor seed sowing, can be advanced in other areas, spring is delayed and so is propagation. Spring and autumn are often mild and ideal for propagation Greenhouses with artificial heat, cold frames, and clockes are used extensively Continental climates often have long, cold winters that delay outdoor propagation and establishment of new plants before the following winter Artificial heat is vital for propagation to extend the season and overwinter new plants. Summers may be too hot for seeds of plants to germinate, when shading for young plants is the priority

WARM TEMPERATE AND SUBTROPICAL AREAS In the Mediterranean, native plants include ohves (Olea europea), Cistus, lavender, and many bulbous plants Humid climates support a diverse and vast range of plants, from bulbs and camelhas to palms, fuchsias, and pines

in warm temperate regions, seeds of cool climate plants may fail to germinate in excessive heat, but propagation can be delayed until autumn, winter, or very early spring. Shade is vital in summer, as is adequate water and humidity. Seeds germinate and cuttings root readily in the natural warmth, so artificial heat is not needed, except sometimes in winter

Subtropical climates are similar but often there is adequate natural humidity

#### **TROPICAL REGIONS**

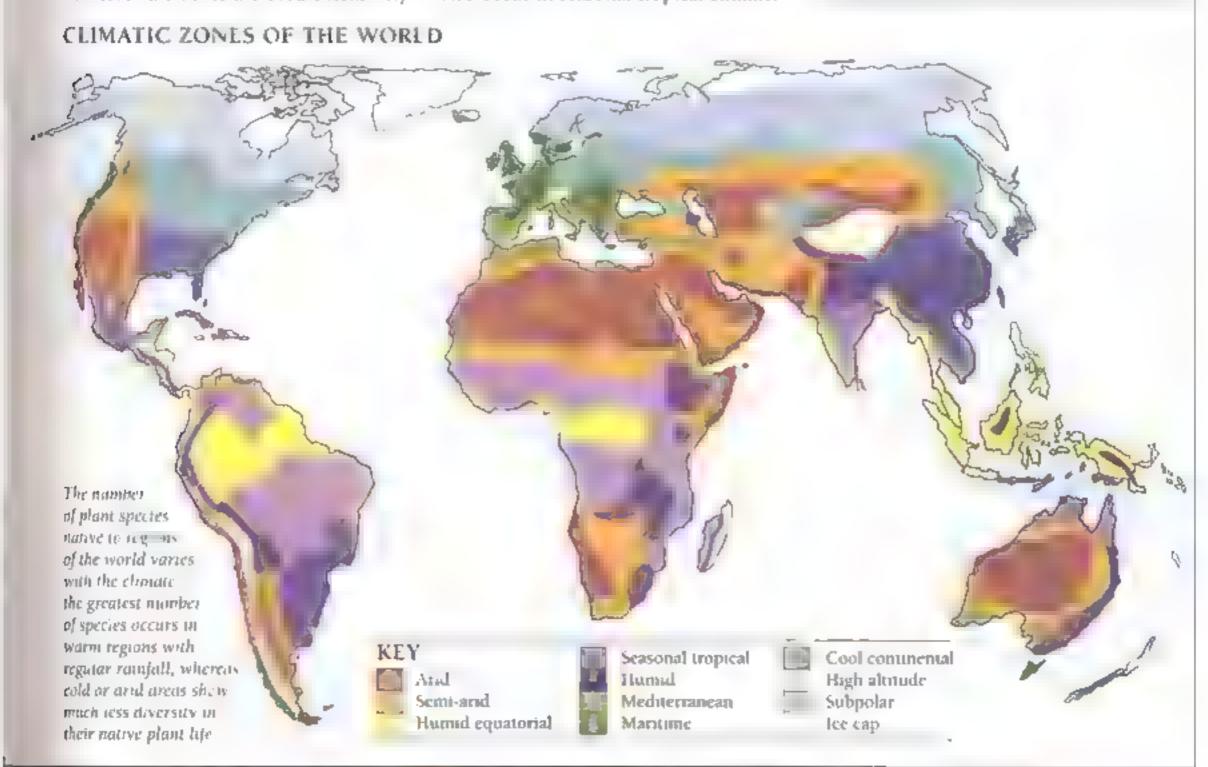
Humid equatorial climates are noted for tropical rainforests with abundant trees, shrubs, and perennials such as bromehads and orchids. Forests packed with plants also occur in seasonal tropical climates With constant warmth, propagation may depend more on rainfall, but take local conditions into account. Shelter and shade are vital. Plants are often started in containers. In seasonal tropical areas, winter may be better for propagation. All propagation can be done outdoors in both climates — cuttings and offsets of plants root freely in open ground.

#### AUSTRALIA AND NEW ZEALAND

Propagation times in this book are primarily for cool temperate climates and may differ in warmer climates of Australia and New Zealand, and regions such as southern California, where there are warm summers and mild winters, because the growing season is longer. Gardeners should use timings given as guidelines only and take account of local conditions.

In general, such climates allow much propagation to be undertaken earlier or later in the year, or outdoors rather than under cover. Check local advice on sowing times for purchased or home-gathered seeds.

Some cool-climate plants do not thrive in warm to subtropical areas in the heat and without a cool, dormant period. Some seeds and bulbs require a cold period in a refrigerator before germination or growth can occur



# THE PROPAGATION ENVIRONMENT

Once any plant material has been correctly prepared for propagation and inserted into a suitable growing medium (see pp 32-35), it is important to provide conditions that will enable the propagated material to survive and establish as a young plant. With a simple process such as division, all that is often required is to replant the divided sections in soil appropriate to the plant's needs or perhaps to grow them on in pots out of drying wind and sun-

Propagation involving regenerative processes, such as the formation of new roots, shoots, or bulblets, immediately demands some form of environmental support until the new plants become independent. This also applies to grafts and much seed propagation

The degree of care needed depends on the species of plant and the mode of propagation used. Easily rooted plants, for example those propagated by hardwood cuttings outdoors in winter require minimal care, in contrast with leafy cuttings taken in summer from a difficult-to-root plant - these will need a closely regulated environment

In colder climates, favorable conditions can often only be achieved. under cover, whether it be in the home conservatory, or greenhouse, to extend the growing season or increase tender plants. For outdoor propagation, cold frames, cloches, or nuesery beds offer a degree of shelter. In warmer regions windbreaks, shading structures, and irrigation systems may be required

Propagating plants away from their natural or adapted habitat makes them vulnerable to attacks from pesis and diseases (see p 46), so the propagation area should be kept as clean as possible

Generally, seeds require water warmth, air (oxygen), and sometimes light to germinate; seedlings and vegetative material need water, warmth, air (oxygen, carbon dioxide), light, and sometimes nutrients to grow

#### THE AERIAL ENVIRONMENT

The humidity of the air affects the rate at which plants transpire, allowing water to evaporate from leaf pores. The more humid the air, the less the plants transpire. This is a critical issue for unrooted leafy cuttings which in spring and summer need an atmosphere of 98-100 percent humidity, and about 90 percent in winter, to prevent wilting Wilting cuttings have a reduced ability to regenerate, form callus ussue at the base, or subsequently develop roots

Cuttings absorb moisture through their cut bases more quickly than through leaves, but once callus tissue forms (in 3-7 days) water can be taken in only by the leaves. The reduced transpiration can stress cuttings. resulting in leaf drop, so humidity is essential for the survival of the cultings

Leafy cuttings obtain energy for rooting by photosynthesis; for this to occur, light, water, and carbon dioxide are needed. Long summer days assist with this process, but intense light in

Motsture from

#### **ELEMENTS TO CONTROL** IN THE ENVIRONMENT

There are two factors to be considered in propagation, the aerial environment and growing medium. Flenients in each must be balanced to encourage growth

#### ATRIAL ENVIRONMENT

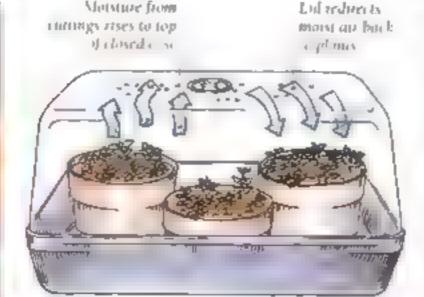
- Humidity: to prevent moisture loss. by transpiration
- Light: to allow photosynthesis without scorching
- Temperature: appropriate to plant
- Air quality oxygen for respiration and carbon dioxide for photosynthesis GROWING MEDICAL
- Moisiure level to encourage roots and for photosynthesis
- Temperature: to encourage growth.
- · Aeranon: sufficient oxygen for growth and to avoid diseases.
- opH (acidity and askalinsty) usually acidic, but appropriate to the plant
- Nutrient level low until roots establish. then increased for steady growth

summer overheats the atr, which in turn causes excessive transpiration and stress to cuttings. Shading (see p 47) to create indirect light aids rooting in a wide range of plants. Photosynthesis is then restricted but can be maximized by ventilating the propagation area to ensure a normal atmospheric balance Ventilation must be regulated to avoid excessive loss of humidity. Plants are

#### MAINTAINING HUMIDITY ON A SMALL SCALE



TENTING The easiest way to cover a single poi is to create a tent over the propagated material with a clean, transparent piastic bag. Hold the bag clear of the plant material with a wire hoop or a few spirt stakes. Alternatively, put the pot in the bag inflate the bag, and seal it



- MOVEMENT OF MOISTURE Propagated material such as leafy cuttings or seeds often must be kept in a contained space to heep the air humid. The cover stops moisture of the atmosphere from evaporating, and the vent allows excess humdity to be controlled
- 7 WINDOWSILL CLOSED CASE Portable closed cases can be used indoors to maintain the high humidity needed to root leafy cuttings or germinate seeds. Some are fitted with electric heating elements to provide bottom heat and modular inserts to make efficient use of the available space.



#### COMMON TYPES OF CLOCHE



BOTTLE CLOCHE M die an individual cloche by cutting the bottom off a clear plastic bottle Leave the bottle cap on and use it as a veni



BELL CLOCHE Much used in the untercenth century these were made of glass and were easy to move from one specto anadice particularly in the kitchen garden. The curved walls ensure that condensation trickly sto the ground instead of lations, est. the young plants. which might cause dannage Bell cloches are now available in glass or less costly plastic



Richto PLAST C. TUNKET

L=08 THE chits can be any
length and as held in position,
by a metal or plastic frame
that an hors it to the so.l.



PLASTIC BARN CLOCKE. The extra height of the sloping top makes this a versatile clocke. Many designs are available in plastic or glass unge clockes will straddie a deep bed, as here



PLASTIC-LIEM TENNEL CECKUF Study were to a some overed by plastic film, which allows easy accessibility but needs catchel pegging down. A long cloche can be divided into sections



FLOATING CLOCKE Made of perforated plastic film or woven polypropylene fleece this prespensive eloche "floats" up as young plants grow. It also allows are and moisture through

temperature-dependent and grow best m warmth, so a minimum temperature appropriate to the plant must also be maintained. All these factors demand a line balance of environmental control.

Other propagation material requires varying degrees of control in the aerial environment (see relevant chapters). Seeds, grafts, and bulbous material all need good ventilation, some humidity and warmth. Bromeliads and orchids need more humidity, and alpines and succulents less, than most plants.

#### PROPAGATION IN THE HOME

The simplest propagation environment can be created by keeping individual containers on a bright windowsill or bay window or in a glassed-in porch. The location provides warmth and light humidity is maintained by covering the container. For a seed tray, use plastic wrap or a sheet of glass or plastic, for a pot of cuttings, use a plastic bag (see far left) or a bottle cloche (see top, left)

#### CLOSED CASES

Closed cases provide the high humidity needed to germinate seeds or root leafy cuttings. Small windowstil closed cases (see Jacing page) work better indoors rather than in a greenhouse. Larger heated closed cases are useful in a greenhouse in cooler climates to create higher temperatures and humidity.

The closed case's heating element should be capable of providing a minimum soil-mix temperature of 59°F (15°C) – or 75°F (24°C) for tropical plant material – in winter and early spring, when outside temperatures may be below freezing. An adjustable thermostat will allow greater control of the temperature

Rigid plastic lids retain heat better than thin plastic covers. Adjustable vents in the lids allow moisture to escape and stop the atmosphere from becoming too humid, encouraging rot Vents should be kept closed until seeds have germinated and cuttings rooted

#### CLOCHES

In the open garden in cooler climates, cloches may be used to warm the soil and air, increase local humidity, and give shelter from drying winds and some protection from pests. They can give seedlings, especially of vegetables an early start, provide a suitable rooting environment for a wide range of easily rooted cuttings, and be used as a temporary shelter to harden off (see p 45) or overwinter new plants

A wide range of designs and materials is available (see above). The best are glass or plastic; plastic allows less light penetration and retains less heat. A minimum thickness of 150 gauge will suffice, but 300, 600 or 800 gauge offers much greater protection. Single-thickness plastic film does not retain heat as well as glass or rigid plastic but is cheaper. Plastic film and rigid polypropylene lasts five years or more rigid, twin-walled polycarbonate lasts for at least ten years (continued on p.40)

#### COLD FRAMES Warmed air escapes carrying heat with a

Cool att enters cold transe and ausanbs iteat

AIR CIRCULATION IN A COLD FRAME Cold air expands and rises as a heats up on a warm day Open the panes of the cold frame in warm weather to allow some warm air to escape and the temperature mside the cold frame to remain reasonably cool. This will reduce the resk of new plants suffering scorch



MOVEABLE COLD FRAME. Glass or plastic francs with lightweight aluminum frames may be placed over prepared soft in the garden to form a narsery bed. Use a sheet mal. It to suppress weeds, plant through sitts in the malch-

(Continued from p.39) Well-fitting end pieces are essential to stop the cloche from becoming a wind tunnel. In sunny weather, shading (see p 45) may be needed to prevent scorching

Rigid cloches are more costly but easier to move about, making watering and transplanting easier. Some are selfwatering, with permeable coverings that allow rainwater to trickle through or a tubular system connected to a hose Floating cloches of woven fleece protect against light frost

#### COLD FRAMES

More permanent structures than cloches, cold frames provide a halfway house between the greenhouse and the open garden in cool climates, providing propagation material and new plants with higher soil and air temperatures, reduced temperature fluctuation, shelter from winds, and adequate light levels.

Cold frames may be used to raise seedlings early in the season, propagate leafless and leafy cuttings, overwinter seedlings and rooted cuttings, protect grafts, and harden off new plants. They may also be used to expose hardy seeds. such as those of alpines and many trees, to a period of winter cold. Cold frames also suit plant material, such as that of gray-foliaged Mediterranean plants or hardwood cuttings, that do not like the humidity of a closed case

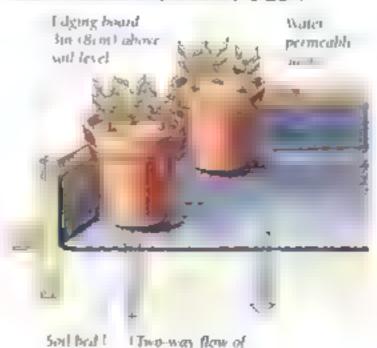


PERMANENT COLD FRAME. A fixed frame. in provide a mirsery bed for seedlings and cuttings Line the base with a thick layer of drainage outerral, such as broken pots ar coarse gravel. Add 6m (15cm) of well-drained soft mix

A good number of pots or trays can be accommodated in a cold frame. Cuttings or seedlings can also be inserted directly to root in a nursery bed in the frame (see above). Soil-warming cables (see (acing page) may be used in the bed

Cold frames with metal frameworks let in most light and can be moved around the garden to follow the best light at different times of year, but they do not retain heat or exclude drafts as

#### OUTDOOR NURSERY BEDS



WATER-PERMEABLE FABRIC BED If the soil is in even or bodly drained, cover it with sand first. Line the soil and edging boards with black plastic, woven fabric, or geotextile. The lining allows soil moisture to reach the pots

water through sed

well as wooden and brick frames. Permanent frames must be sited in a sheltered position, where maximum light is received in winter and spring

Cold frames overheat in sun unless they are ventilated (see left) and shaded well. Hinged panes (covers) can be wedged open to stop overheating but may admit strong winds. Sliding panes can be removed entirely, but this leaves plants unprotected in hard rain

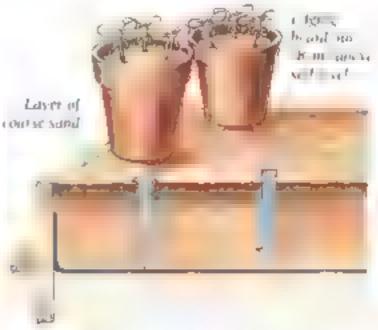
If the temperature falls below 23"1 (-5°C), insulate the frame to avoid cold damage. Wrap the outside with thick layers of burlap or polyester blankets, hne the inside with styroloain, or, in daytime, use bubble plastic so that light can still pass through

#### KEEPING OUT WORMS

In the open garden, worms are great aerators of the soil and are the gardener's linends, but in a container in a cold frame. they are menaces. The worms are forced to go around and around, compacting the soil mix instead of aerating it To stop most worms, line the frame with water-permeable fabric or line the bases of pois with window screening A drench of a very dilute solution of potassium permanganate will bring any worms to the surface

#### OUTDOOR NURSERY BEDS

Large numbers of new plants and seedlings in containers can be grown on in an outdoor nursery bed. The beds suppress weeds, isolate young plants from soil-borne diseases, and enable containers to drain freely while giving plants access to water through capillary action. Sand beds require the least watering. Level a site, enclose it with 3in (8cm) high wooden boards, then line it with (abric or sand (see below)



In was flow of water through sand Soil bed i

Plasta sheeting cur In (2 5cm) below top of edging bounds

SAND BED. Line the bed with a double plastic sheet Cover with sand to within 1 in (2.5cm) of the top. Trim the plastic sheet, fill to the top with sand, level. The sand is a water reservoir excess water drains away between the board and lining

#### THE GROWING-MEDIUM ENVIRONMENT

The choice of growing medium should provide the propagated material with the appropriate pH level and amount of oxygen and nutrients (see pp.32–5), but correct watering and temperature control of the medium is needed for the various growth processes, such as root initiation or seed germination, to occur

The growing medium must be kept moist, but not waterlogged, which will deprive the roots or seeds of oxygen and promote rot. Initially, if the propagated material is covered, the moisture level in the growing medium will remain fairly constant, but once growth begins the growing medium should be watered when needed to keep it moist (see p 44)

The temperature of the growing medium can affect certain biological processes that indirectly affect plant

growth, such as the release of fertilizer nutrients into soil mix

For most propagation under cover the growing medium should be heated separately – if not, its temperature will normally fall below that of the air. The reasons for this are the transfer of heat into cooler areas beneath the medium evaporation cooling the surface; any watering or misting with cool water and loss of radiant heat at night

To counteract these effects, a system providing thermostatically controlled bottom or basal, heat can be used to ensure that the growing medium is of a higher temperature than the air hence the old adage "warm bottoms, cold tops." This enables unrooted leafy cuttings in particular to avoid moisture stress during root formation, especially during high summer

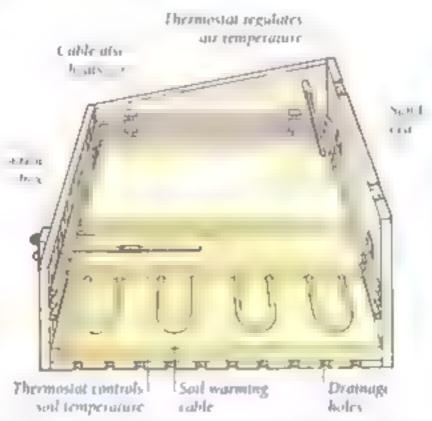
Bottom heat that is as high as 77–86°F (25–30°C) can cause a decline in root growth. The optimum temperature for root formation, at minimum cost, is within 59–77°F (15–25°C) for most material, 64°F (18°C) is a good average

There are various ways of supplying bottom heat (see below). The simplest is in a heated closed case. Soil-warming cables are sold in varying lengths and wattages that are designed to heat given areas, such as a bench or closed case. For mist propagation (see p. 44), use twice the standard amount of cable. Use a cable with a wired-in thermostat connected to a grounded socket with a circuit breaker. If using a propagating blanket, place a plastic hood over seed trays to maintain humidity. An organic hot bed is a fairly inexpensive option but it cannot be precisely regulated.

#### PROVIDING BOTTOM HEAT



EFFECTS OF BOTTOM HEAT of the temperature of the rooting medium is warmer than the air cattings usually mot more quickly and strongly Seeds may also germinate more successfully.



50IL-WARMING CABIT. Lay the cable used here in a propagating case, in a series of "5" bends in a bed of moist said at a depth of 2+3in (5+8cm), making sure that the loops do not touch. Cables can also be used to warm air in enclosed spaces, as in this instance

#### MAKING A HOT BED



Fork over the soil in a greenhouse berief Cover with a 9in (23cm) layer of fresh, strawy horse manure and 2in (5cm) of soil Dust with time to neutralize the acidity



2 Build up the bed with two more layers of manure, soil, and lime, finishing with a firm, level layer of soil. Leave for a day or so for the bed to start heating up before use



#### THE GREENHOUSE

For those interested in propagating plants in cold climates, a greenhouse is a valuable asset, allowing a sophisticated degree of environmental regulation. There are many different styles available. Some models are designed for maximum light penetration, heat conservation, or ventilation, while others make the most economical use of space.

A lean-to or mini-greenhouse benefits from the warmth and insulation of the house wall, but extreme temperature changes are more common. Plastic tunnels are mostly used for raising crops at soil level. They offer some protection from cold and winds but not the warm conditions of a traditional greenhouse Ventilation may be a problem

The minimum temperature in the greenhouse will determine the range of plants that can be propagated. There are four categories of greenhouse cold cool, temperate and warm

A cold greenhouse is not heated at all and may be useful for propagating alpines and cuttings, overwintering plants, and raising summer crops and hardy seedlings

A cool greenhouse is heated just enough to keep it above freezing, with minimum daytime temperatures of 41–50°F (5–10°C) and a nighttime minimum of 36°F (2°C). It is good for overwintering tender rooted cuttings and raising early bedding plants. A closed case must be used to germinate seeds of to root cuttings.

A temperate greenhouse has minimum daytime temperatures of 50–55°F (10–13°C) and a nighttime minimum of 45°F (7°C). Additional warmth may be needed for propagation in spring. It is used mainly for hardy to slightly tender material, such as many bedding or vegetable crops

A warm greenhouse has high humidity and a daytime temperature of at least 55-64°F (13-18°C), with a nighttime minimum of 55°F (13°C). A wide range of plants can be propagated, including tropical and subtropical plants – many without special propagation equipment

#### REGULATING THE ATMOSPHERE

During the growing season, relative humidity in the greenhouse of 40-75 percent is beneficial. In winter, lower humidity is needed, at an appropriate level for the plants. Wet and dry bulb thermometers, used with hygrometric tables, or hygrometers, may be used to measure relative humidity. The level of humidity is somewhat dependent on the air temperature, since warm air holds more water than cold. Humidity may be increased by splashing water on the floor or staging ("damping down") mist-spraying automatically or by hand, or allowing water in a tray to evaporate Humidity is decreased by ventilation

A minimum temperature may be maintained by use of electric gas or kerosene heaters. Electric ones are most efficient and reliable and usually have a thermostat, which means that no heat is wasted. Electric fan heaters are the most useful, ensuring good air circulation. Kerosene heaters are least efficient, since they are not controlled by a thermostat and produce plant-toxic fumes and water vapor. If the heater has no thermostat, use a maximum/minimum thermometer to monitor nighttime temperatures. In cold regions, a cold alarm is useful.

Adequate ventilation is essential to control air temperature and humidity. The area covered by ventilators should be equal to one-sixth of the greenhouse floor. Use air vents, louver windows.

GROW LAMP

Special lamps are used to extend dayleigth and promote early germination of rooting or improve growth of new plants, especially in winter or spring. They may be metal halide (closest to natural light), mercury vapor, or fluorescent and have reflectors that direct light onto plants and features trisidated against hiomid on

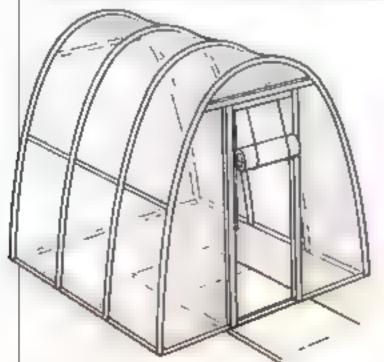
extractor lans, or automatic systems (see Jacing page) to avoid a buildup of overheated air in warm weather, of stuffy, damp air in cold conditions, or of fumes from gas or kerosene heaters

Louver ventilators are usually below the staging and are useful for controlling air flow through the greenhouse in winter, when roof ventilators may allow too much heat to escape. Vents must close tightly to exclude drafts. Use a household extractor fan that is powerful enough for the size of the greenhouse, and install it at the opposite end of the greenhouse to a door or louver window to replace stale air with fresh

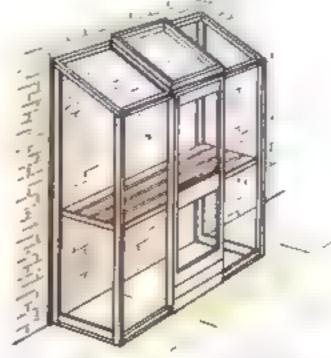
In hot weather, external shading helps control the air temperature and protect propagated material from stress and scorching sunlight, use specially formulated shading washes (see p 45), blinds (see facing page), flexible mesh or fabric or rigid polycarbonate sheets. A shading wash should be applied to reduce the bright sunlight of summer then washed off with a cleaning solution. Shading fabric may be hung on wire runners across or along the length of the propagating bench or greenhouse.

Blinds are used mainly externally and are more versatile than washes, since they may be rolled up or down or used in only one section of the greenhouse, as necessary. Flexible shading meshes can be used externally or internally, and although they are less adaptable than blinds, they can be cut to length and placed in position for a season.

#### ALTERNATIVE TYPES OF GREENHOUSE



PLASTIC TUNNEL GREENITOUSE This is a low-cost structure, made of a large, tunnel-shaped frame covered with heavy-duty transparent plastic. The plastic is good only for a year or so it becomes opaque, reducing again procession.



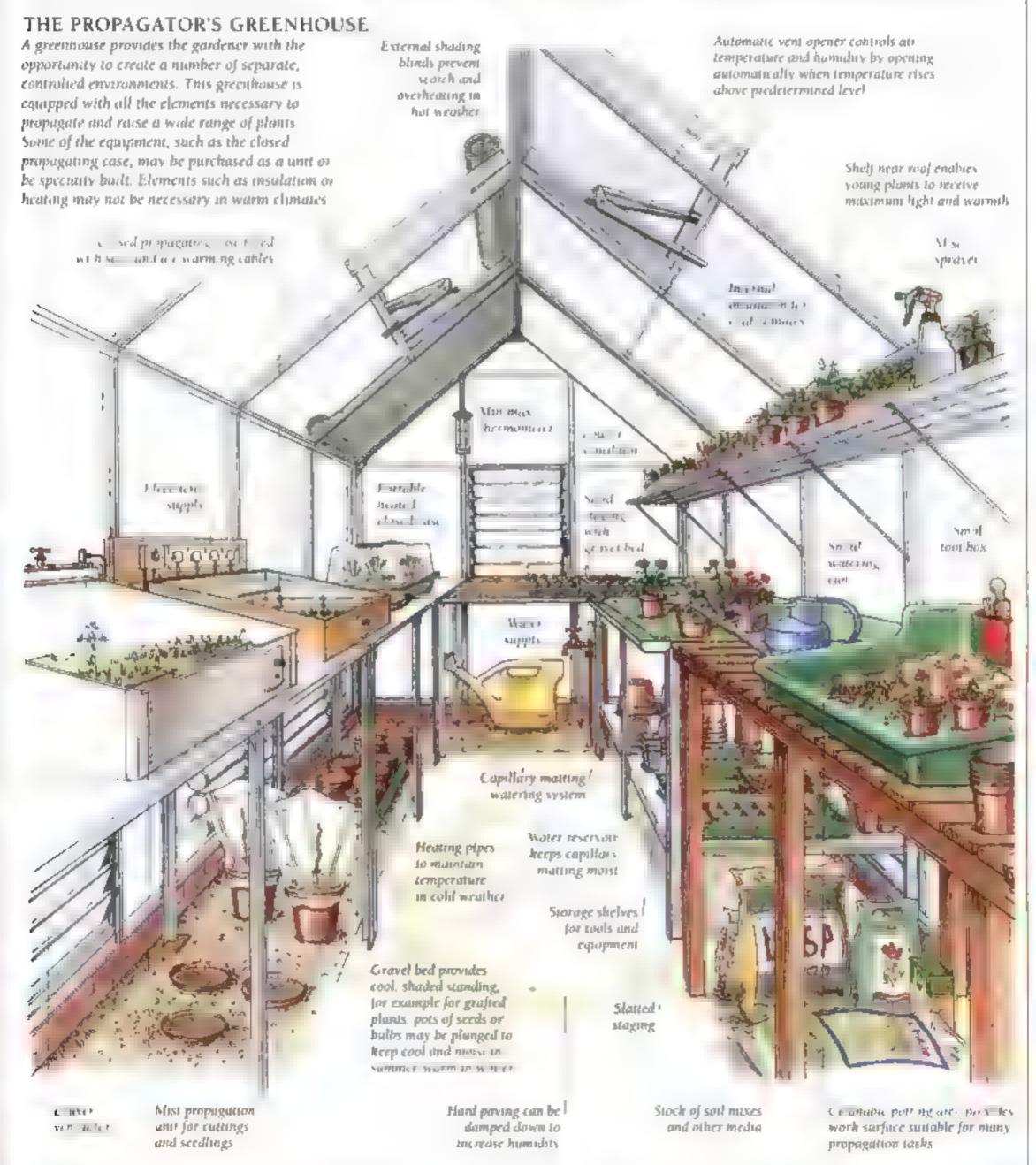
MINE-GREENHOUSE Usually aluminum framed, this is a useful propagating area if space \(\sigma\) limited. Place against a wall or fence facing south (Northern Hentisphere) or north (Southern Hentisphere) for maximum heat and light

Winter insulation can supplement and reduce the cost of heating but may also diminish light levels. Bubble plastic, which consists of double or triple skins of transparent plastic with air cells in between, can be cut to size and is very efficient. A single layer of plastic sheeting may also be used – it is less expensive and cuts out less light

Thermal screens are good for conserving heat at night. They consist of sheets of clear plastic or translucent fabric hung on wires between the eaves and drawn horizontally across the greenhouse in the evening. A high-humidity area for tropical plants or a warmer area for early seedlings may be created at one end of the greenhouse with a vertical screen

#### GREENHOUSE STAGING

For propagation, it is most useful to have staging, whether permanent or freestanding, around the three sides of the greenhouse. There should be a good-sized gap between the back of the staging and the greenhouse walls to allow for air circulation. Slatted or mesh benches permit a (continued on p.44)





PLASTIC-FILM TENT This way of covering a heated bench is used widely in plant nurseries to keep the air haned wait cultings root. Tre 4/1 el 2m) stakes to the legs of the bench or staging Make hoops of strong wire and mserr the ends one the tops of the stakes. Drape a sheet of opaque plastic over the hoops so that it completely encloses the top of the bench

(continued from p 43) freer flow of air than solid staging, they are useful for raising plants in pots, such as alpines or caett and succulents that need very free-draining growing media. Solid surface staging can be fitted with a capillary (see p 43) or a trickle-hose watering system

fo convert solid surface staging into a propagating bench, choose a bench that is at least 4in (10cm) deep. Line the base with a 1in (25cm) layer of small gravel or clay pellets, then 1in (25cm) of coarse horticultural sand Lay soil-warming cables (see p.41) and cover with another 1in (25cm) of sand Fill it with soil mix for direct rooting of cuttings or more sand to provide bottom heat for containers. Alternatively, use a propagating blanket (see p.41). The bench may also be covered with plastic film for extra humidity (see above)

#### GREENHOUSE WATERING SYSTEMS

A watering can fitted with a fine rose is the most efficient way to water a mixed collection of new plants, especially in colder weather. In spring, delicate new plants can be damaged by cold water. Always fill a watering can and allow it to stand, or keep a water tank under the staging, so that the water is the same temperature as in the greenhouse.

In very warm conditions, automatic systems save time. A capillary system consists of a %-2in (2-5cm) deep sand bed or layer of capillary matting that is kept constantly wet by water from a reservoir (see p 43). The water seeps into the sand or matting and then into pots or seed trays by capillary action. Plastic pots usually allow good contact with the capillary layer, but clay pots may need a wick of capillary matting to be placed in each drainage hole. These systems are too wet for winter use.

Irickle urrigation systems employ a network of narrow-gauge tubing that carries water from a reservoir to individual containers. The reservoir is relified regularly or fed by the water supply. Nozzles on each tube release water drop by drop and can be adjusted to suit the needs of each container of plants.

Seep hoses, widely used in the open garden, are perforated so that water seeps out along the length of the hoses, but these may not be able to supply a sufficient amount of water in a very warm greenhouse

#### PLASTIC-FILM PROPAGATION

Used for a wide range of plants, including subtropical and tropical ones, plastic-film propagation involves laying a sheet of clear or opaque plastic directly onto pots or trays of cuttings after watering them in. This is an inexpensive way of creating high humidity and warmth around the cuttings, but it needs careful management. The cuttings must be ventilated to avoid excess condensation,

but without loss of humidity. The piastic film should be removed at least once a week for about 30 minutes

This technique is also used in plastic tunnels to create extra warmth. Some cuttings, especially those with hairy leaves, are better left uncovered. In an enclosed environment, the hairs trap water droplets, which can lead to rot Cuttings with waxy or succulent leaves are also prone to rot if covered.

#### SPECIALIZED PROPAGATION UNITS

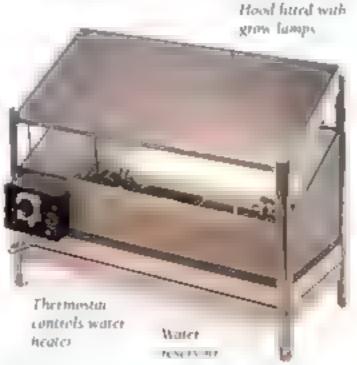
Leafy cuttings may be rooted in mistand fog-propagation units more rapidly and in larger numbers than by other, more conventional means. These automatic systems are based on those in use in commercial nurseries (see below and p.14). They provide a constantly warm and humid environment, so avoiding the need to water and reducing heat loss by evaporation and moisture loss by transpiration. The cuttings are less prone to fungal diseases, since spores are washed out of the air and from leaves before they can infect plant tissues.

Mist propagation covers cuttings with a film of water; fog propagation avoids this by creating a finer vapor so is best for cuttings that are susceptible to rot Mist units are not generally covered, but this can create too humid an atmosphere for other plants in the greenhouse

#### GRAFTED PLANTS UNDER COVER

Grafted plants already possess roots and shoots but need warmth and humdity at the union of the rootstock and seron to encourage it to callus over ("heal," see p.27). This may be achieved by tenting each graft in a plastic bag (see p.38), using plastic film (see above), or placing the graft union in a special hot-air pipe (see p.109). Too much warmth at the

#### SPECIALIZED PROPAGATION UNITS



FOG PROPAGATION UNIT. This unit pumps fresh air through a water reservoir, creating a warm "fog" around the propagated material without wetting the leaves. Vapor condenses on the sides and runs back into the reservoir



MIST PROPAGATION UNIT The misting head automatically delivers an intermittent spray of fine droplets over the propagated plants. The heated bench aids rooting, while the mist cools the topgrowth and prevents moisture loss

#### USING SHADING TO PROTECT NEW PLANTS

Shading should protect plant material from being scorched by direct sun while still allowing sufficient light for good growth to pass through it. Some shading materials are used for the greenhouse (see p.42), for example shading washes, but others can be

used on smaller structures, such as flexible meshes (see below) and newpaper. In warmer chimates, shade houses are useful These are constructed from wooden slats brushwood, or woven shadecloth, slats are best because they create dappled light.



FLEXIBLE MESH Plastic mesh can be cut to size and used as internal or exterior shading. The amount of shade given depends on the mesh size



SHADING WASH Washes make very effective shading because they reduce the heat from the sun significantly while allowing enough light through for good plant growth Apply the wash externally



SIN It socials in chinates with hot sun, tunnel cloches of white woven material stretched over with hoops may be constructed to any lengulation factories to the hot reduce the host much

roots or shoots encourages early root and bud growth before the graft union has formed

#### WEANING PROPAGATED PLANTS

Once the propagated plants have fully functioning root and shoot systems that are adequate for independent survival the process of weaning the new plants from the propagation environment into a growing environment should take place. The amount of care needed for this process depends on the species made of propagation, time of year, and type of propagation environment.

Leafy cuttings that have been rooted in summer in mist of log propagation units or under plastic film are most vulnerable during weaning. It may take 2-3 weeks for the plants to fully ace imatize First, bottom heat is turned off, allowing it to fail naturally to the air temperature. The humidity level is then gradually reduced. Plastic film is removed for a longer period each day after 3-7 days, the covers should not be replaced at night. A similar program is followed for mist and fog propagation units: the duration and frequency of the mist or fog bursts are reduced, then the units are switched off at night

Other propagated plants that are in covered or special environments within the greenhouse, such as closed cases, covered benches, or high-humidity tenis, should be gradually exposed to the open greenhouse atmosphere over 1–3 weeks

Once weaned, new plants can be placed in well-ventilated areas at temperatures appropriate to the species. They should be shaded because direct sunlight heats the air, causing stress in young plants and scorching tender new foliage

At this stage, excessive growth should be discouraged to avoid shoots developing at a faster rate than can be supported by the new roots. This can be achieved by keeping the growing medium slightly drier than before

If new plants are to be overwintered under cover, a frost-free environment is sufficient for hardy plants. More tender subjects should be kept at a minimum temperature appropriate to their needs



HARDENING OFF NEW PLANTS In cold climates, a cold frame provides a good halfway house between the greenhouse and the open garden. Keep new plants in the cold frame for 1–3 weeks before planting out

Some commercial growers have an automatic system to brush the tops of seedlings, especially of vegetables, for 1–2 minutes per day: this mimics the effects of wind and rain, making growth sturdier and more robust. Gardeners can do the same, lightly brushing seedlings with hands or a piece of cardboard.

#### HARDEN NG OFF

Before planting out, young plants must be hardened off – acclimatized to the temperatures outdoors. This may take 1–3 weeks and must not be rushed because, over a period of days, the natural waxes coating the leaves must undergo changes in form and thickness to reduce water loss. Stomatal pores on the leaf also need to adapt to the less favorable conditions

Transferring young plants to a cold frame is ideal – it can be ventilated increasingly, as conditions permit, until the covers are fully open at night as well as by day. A cloche may also be used but does not give as much cold protection as a cold frame. Alternatively, place the containers near a wall or bedge and cover at night, and by day in poor conditions, with newspaper, plastic sheeting, or shade netting.

#### PROTECTING OUTDOOR BEDS

Outdoor seedbeds and nursery beds do not have the controlled environment found under cover but may need some form of protection. Drying winds can stress plant material by increasing moisture loss erect windbreaks on the side of the prevailing winds or use clockes. In warm climates or seasons, beds may need irrigation, seep hoses (see facing page) are useful, lay them along the feet of the new plants.

Barriers can be erected to protect the beds against pests, for example, yarn can be strung across seedbeds to deter birds, and barriers of mesh or fleece put up to stop rodents or carrot root maggot



PROTECTION AGAINST PLSTS
Birds and rodents can devastore seedbeds. Bord
wire netting that has a mesh no bigger than I in
2 5cm) to form a cage and peg it firmly into the
soil. The mesh also serves as a plant support

# PLANT PROBLEMS

In nature, plants adapt to share specific environments with a wide range of both beneficial and hostile organisms, such as animals, insects, bacteria, and viruses, forming a complex structure of relationships that allow the plants to thrive. Propagated plants are usually removed and isolated from this natural balance in a type of monoculture that leaves them vulnerable to attack from harmful pests and diseases

The use of bottom heat, frequent watering, and high humidity that are so often essential in propagation also encourage the proliferation of a range of debilitating fungi. These are often introduced through poor hygiene in preparation of the plant material or in contaminated soil mixes and include species of Phytophthora, Pythium, and Rhizoctonia, which cause damping off (see below) and seedling blight

It is best to try to prevent plant problems occurring at all and, if this fails, to recognize and treat them at an early stage. The pictures below and the chart opposite describe some diseases, pests, and disorders affecting new plants

#### PREVENTING PROBLEMS

The first principle of propagation is to take material from healthy, strong plants, pests and diseases can be transmitted from the parent. This can be a particular problem with viruses (see below) and pests that are not easily discernable such as nematodes (see right), plants prone to such problems, such as Phlox, are best raised from seeds or root cuttings

To avoid introducing pests or diseases when preparing material, especially if any wounding is involved, it is wise to observe good hygiene (see p.30) and to use sterile growing media (see p.32). Providing the best possible conditions for the propagated material (see The Propagation Environment, pp.38–45) ensures it is less vulnerable to attack.

Certain pests can be troublesome if they gain a hold in the propagation environment. Spider mites, for instance hibernate during winter in nooks and crannies in the greenhouse. To avoid an infestation during the growing season scrub the propagation area annually with a solution of disinfectant. This also helps control whiteflies, mildew, and the various fungi that cause damping off or blackleg (see below). Outdoors, use barriers (see p.45) against pests, such as mice (see below), birds, and rabbits, which damage seedlings and new plants.

#### CONTROLLING PROBLEMS

Regularly check new plants and control any problems as soon as they arise for example, discard any cuttings that show signs of rot, viruses, or cold damage (see below). If using organic or chemical controls, choose the most appropriate product available in your area.

#### COMMON PROBLEMS AFFECTING PROPAGATED MATERIAL



Virtists Leaves and stems are stanted or distorted and usualty develop vellow streaks mottong, or spots. There are many viruses that are often transmitted from infected parents or by sap feeding assects, such as aphads. Destroy affected plants promptly and clean hands and tools thoroughly after handling.



APHIDS These sup-feeding insects cause stunted growth and distorted leaves and excrete sugary honeydew on which souty mold grows, especially in high humidity. Organic insecticides include pyrethrum, derris, and insecticidal soups, if you i hoose to use a stronger chemical control exercise enation.



BLACKLEG Before or as roots form, the base of a cutting darkens and atropines the upper parts then discolor and die. This is caused by soil water-borne (ungi being introduced through diffy containers, tools, toisieringed soil mix or water. Always observe strict hygiene and use a fongicidal rooting compound and clean water.



DAMPING OFF Seedlings flop over, often with a brown shrunken ring at the stem base, and white fungus appears. The water- and soil-borne fungi spread rapidly in wet soil inix, humid warmth poor light, and dense sowings. When sowing observe good hygiene and sow thinly. Treat with a fungicide



COLD DAMAGE. The upper parts of leaves on cuttings or seedings turn brown or biaca or appear pale green or brown as if scorched and may will, wither, or die back. Nip off affected leaves or discard severely damaged plants. Prevent cold damage by ensuring a warm environment, such as in a heated closed case.



MOUSE DAMAGE Seeds, especially pea, bean and corn seeds, and crocus corms outdoors are eaten, leaving the shoots lying on the surface from the soil over crocus corms to stop mice from discovering them. Cover a newly sown seedbed with wire netting, set mouse traps nearby, or sow the seeds indoors.

#### OTHER COMMON PROBLEMS AFFECTING PROPAGATED MATERIAL

#### PROBLEM

# Downy Mr. BEW Yellow or discolored areas on upper leaf surfaces, corresponding to fuzzy, grayish white or purpush fungal growth beneath common on young plants infection may spread and seedings can be killed or their growth badly checked

FROCATION Plant looks pale with poor leaf development and widely spaced nodes

FROT AND REAT ROTS. Deterioration of tissues around the stem base, causing upper parts of plant to wilt, discolor, and die Roots may turn black and break or rea.

Fungus GNAT Grayish brown flies. Sin (3-4mm) long, fly or run over soil man Seedlings and cultings fail to grow Iranslucent white larvae may be seen

GRAY MOLD (BOTRYTIS). Gray, occasionally off-white or gray-brown, fuzzy, fungal growth develops on infected areas and may attack all parts above ground. Usually gains entry via wounds or points of damage.

NEMATORIA. These sap-feeding pests leave no visible holes in the leaves but release a toxic sal va that reso is in leaf distortion and discoloration. Soil-dwelling nematodes can RE froots and spread views diseases.

POWDERY MILBEW White, powdery, fungatgrowth on upper leaf surfaces, and then on all parts above ground. Affected parts, especialty young foliage, may yellow and become distorted. Growth may be poor, in ox reme cases causing dieback and death

RUSTS Patches of spores, either as masses or pustures, usually bright orange or dark brown, develop on the lower leaf surface with yellow discontinuous above

Scene is cases with turn ye low or brown, become dry and crisp, and may die margins are affected first. Stems may die back

51.065 AND SNAILS Tregular holes appear in Johage of seedings and cuttings, and stems are damaged at soil level. Slimy muciliage may leave a distinctive silvery deposit.

Spinen autes Leaves develop a fine pare morting on the upper surface forage becomes dull green, then yellowish white Leaves fad prematurely, and a fine silk webbing may cover the plant.

THRUS A fine solver-white discoloration motified with tiny black data, appears on the upper surface of the leaves.

Vine Weevit Lauvae. Plants grow slowly, with and may die. Outer tissues of seedlings of woody plants and cuttings may be gnawed from the stems below ground.

Wineworms Stems of seedlings are bitten through just below soil level

#### CAUSE

Several different fungs, in particular species of Peronospora, Bremto, and Plasmopara, which are encouraged by humid conditions.

Inadequate light supply, causing extended growth toward light source and abnormal chlorophyll development

A range of soil- and water-borne fungi that flourish where growing conditions are not adequately hygiente. Tomatoes cucumbers, and melons are sometimes affected, especially in greenhouses. If unchecked, fungi build up in the soil

Black-headed larvae, up to 5m (5mm) long, of flies (such as Bradysia) feed mainly on decaying organic matter but also toots of seedlings and cuttings. They may bore this the bases of stems of cuttings.

A common fungus, Botrytis cinerea, that thrives in damp conditions. Its spores are almost always present in the air and are spread by rain or water splash and air currents spores may persist year to year as hard, black sclerous idormant spores) in soil or on infected plant debris.

Microscopic, wormalite animals that feed in host plant such as nateissus nematode or live in soil and attack root hairs (Protylenchus, Longidorus, Trichodorus, Xiphinema species). Main pesis on flowering plants in greenhouses are leaf nematodes (Aphelencholder species).

Various lungi, in particular many species of Ordiam.

Microsphaera. Podosphaera. Uncionia. Erysiphe, and

Phytlactinea, which thrive on plants growing in dry soil

Some only infect a single genus or closely related host

plants, other attack widely Spores are spread by wind and
taits splash, the lungi may overwinier on plant surfaces.

Various lung) most often Puccinia and Melampiona species, which thrive in humid conditions. The spores are spread by water splash and air currents.

Excessively high temperatures, especially in a greenhouse, bright but not necessarily hot sunlight, or wind drying out the leaves.

Slugs (such as Milax. Arion, and Derocetas species) and snails (such as ficier aspersa): these are show-bodied mollisists that feed on soft plant material, mainly at high or after two

Sup-feeding mites. Terranychus urticae that attack a wide range of indoor and greenhouse plants and those outdoors in warm, dry sites. Mites are less than %in (Imm) long and have four pairs of legs. They breed rapidly in warm, dry conditions, some have resistance to miticides.

There are many different species of thrips – narrowbodied, clongate, brownish black insects to Xin (2mm) long, sometimes crossed with pale bands, that feed by sucking sap. They theire in hot, dry conditions

Plump, creamy white, legless grubs of the beetle Ottorhynchus sulcatus, up to Sin (1cm) long, with brown heads and slightly curved bodies that live in soil and feed on roots. Long-term, container-grown plants, such as cuttings and seedlings of woody plants, are most at risk

Slender, stiff-bodied, orange-brown larvae of click beeiles issued as Agriotet species), to 1in (2.5cm) long, that live in soil. They are most numerous in newly dug grassland, but gradually decline if land is cultivated regularly.

#### CONTROL

Remove infected leaves as soon as seen. Improve air circulation around plants by extra spating and weed control. In greenhouse increase ventilation, avoid overhead watering and crowding of pois or trays. Spray infected plants with suitable fungicide.

Move plants to a bright, any location. Provide adequate light for newly germinated seedlings.

No cute available. To avoid spread of fungt discard infected plants promptly, together with the soil or soil mix around the roots. Good hygiene prevents introduction and spread. Replant resistant plants

Maintain good hygiene and avoid overwaiezing introduce a predatory mite (hypoaspis miles) or nematode (Heterorhabditis) to feed on grubs. Drettch soil mix with spray-strength permethrin

Remove dead or injured plant parts before they are infected, custing back into healthy growth. Do not leave plant debris lying around. Improve air circulation and reduce humidity. Sprity with a suitable fungicide.

Do not replant parts of gardens from which infected plants have been removed with the same types of plant. Strict hygiene is essential; discard all infested leaves and plants. No effective themical control for nematodes.

Avoid day sites and musch as necessary, keep plants adequately watered but avoid overhead watering. Remove infected leaves immediately spray with a suitable longicide.

Remove infected leaves, improve air circulation and discourage lush growth. Spray plants with a suitable lungicide.

Try to prevent it from occurring by improving ventilation, providing shade and damping down the greenhouse floor or giving shelter from wind

Protect vulnerable plants, especially in wet weather Remove by hand after dark or during overcast days, use beer traps or barriers such as diatomaccous earth. Scatter poisoned baits among plants

Maintain high humidity. Under cover introduce the predatory mite Phytoseratus persimilis before a heavy infestation develops. Plants may be sprayed with an insecticidal soap or other pesticide.

Water plants regularly, improve air circulation and lower temperature. Spray with a suitable posticide when signs of damage are seen.

Good hygiene avoids providing shelters for admis Water a pathogenic nematode (Heterorhabditis or Sicularnema species) into the soil or soil mix in late summer before the grubs become too large

Where damage is seen, lure worms to gather under bits of wood, then destroy them. Regularly cultivate and weed the soil. Protect seedlings by dusting seed rows with Insecticide





# GARDEN TREES

With their distinctive silhouettes and longevity, trees provide continuity and structure in the garden. They are expensive to buy but not especially hard to propagate and, once established, will give pleasure for generations to come.

Trees may provide the framework or focal point of a garden and may link the garden with the landscape beyond. They are woody perennials with a crown of branches, usually at the top of a single stem or trunk, and include conifers, or cone-bearing trees. Palms and cycads are also mostly treelike in form. Valued for their shape, which provides year-round interest, many trees also offer seasonal displays of handsome foliage and bark, showy flowers, and brilliant berries. While some are purely ornamental, other trees also bear edible crops

Since they are slow-growing compared with herbaceous plants, trees tend to be expensive, so it may be worth growing your own, especially if a number of plants are needed for hedges, orchards, woodland gardens, or screening. Propagating trees also makes it possible to obtain more unusual species, replace declining trees, or determine the size and shape of the tree

Taking cuttings is commonly used to increase many ornamental trees because it is fairly simple and provides new plants quite quickly. Trees naturally reproduce from seeds, so this is an easy way to raise species. Hybrids and cultivars rarely come true to type, but natural seedling variation

AUTUMN HARVEST

The horse chestnut (Aesculus hippocastanum) often produces a prolific crop of fruits. These are best gathered as soon as they fall and, once the spiny hasks are removed, sown fresh in pots of in nursery beds of fertite soil

may yield a new variety. Seed-raised trees usually take at least twice as long to reach flowering size than do those that have been propagated by vegetative techniques

Grafting and budding are the principal ways of propagating fruit trees, joining fruiting cultivars with specifically bred rootstocks to restrict their growth or provide disease resistance. The new plants also establish quickly. Much used by commercial growers, grafting and budding are often shrouded in mystery, but some of the techniques are well within the capabilities of the avid gardener. Grafting and budding also may be used for ornamental trees that are difficult or slow to propagate by other means. Layering, whether simple layering that occurs naturally with some trees or air layering, is another option when only

PAULOWNIA TOMENTOSA "Eilacina"

one or two new plants

are required

This tree thrives in climates with long, hot summers and its usually grown from seeds or root cuttings. Clusters of flowers at the shoot tips appear before the feaves, followed by large woods seedpods that split pen when ripe to release flat seeds.



# TAKING CUTTINGS

Taking cuttings is one of the most common propagation methods for trees, it is usually fairly simple and provides new plants relatively quickly, although care is needed when selecting cuttings material. Most hardwood cuttings will yield a sapling ready for planting out in one year, other types of cutting need to be grown on for 2–3 years. A few species, such as some conifers, take up to five years.

#### HARDWOOD CUTTINGS

This is one of the easiest and least costly ways of raising many deciduous trees it requires no special skill other than knowing which trees are suitable, when to take the cuttings, and how to provide basic conditions for rooting and growth

The time to take the cuttings is during a tree's dormant period, usually from mid- to late autumn and in late winter, the best times being immediately after leaf-fall or just before bud break. Look for healthy, vigorous shoots avoiding weak or very spindly growth (see above). In most cases, cut off each shoot at the union of the one- and two-year-old wood (see below). With very

vigorous plants such as poplars (Populus) or willows (Salex) that root readily, take material from well-ripened wood of the current season's growth The length of prepared cuttings varies enormously

they are commonly about 8m (20cm) but may be as long as 6ft (2m) in some instances, as for certain willows. The diameter also varies, depending on the length of the shoot, from pencil thickness to about 3m (8cm)

For plants that root easily, the simplest way to root hardwood cuttings is in open ground. For this purpose, it is best to use a patch that has been cultivated, with a soil that is open and friable. You can then easily insert the cuttings into the soil. If the soil is at all heavy, however, insert the cuttings in a shit trench, as shown below. The planting depth depends on whether you are raising single- or multistemmed trees (see box, bottom left). Check each row after winter because frost may have caused the trench to open, in which case the cuttings should be refirmed.



For trees that are slow to root, such as Metasequoia (dawn redwood) or Labarium, overwinter bundles of cuttings in sand (see facing page). Each hundle should have no more than ten cuttings, otherwise, the ones in the middle will dry out. Sand will allow the cuttings to undergo a period of cold but will protect them from wide fluctuations in temperature. Use sharp sand with no soil in it so that the surface does not cap over," or form a crust. Make sure it is moist, and periodically check moisture levels.

Leave the cuttings in the sand until just before bud break in early spring then line them out in a nursery bed or pot individually in containers. In the following autumn, if the saplings are large enough, plant them out in their permanent positions. Otherwise, lift

#### FAST-ROOTING HARDWOOD CUTTINGS



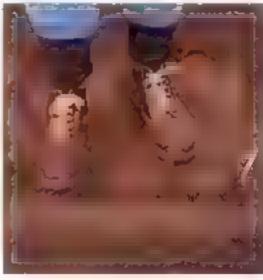
I be autione, make a new way onch 6-10m (1 m25cm) deep by pushing the spade into the soil and pressing it slightly forward to improve drainage sprinkle some sharp sand into the trench bottom



2 belief a well repended shoot at least 12 n (30cm) long from the current seasons growth (ben to be fire because americana). Make the cut so that it is thish with the main stem, or just above a bud



3 soft growth from the tip of each cutting. Term the cutting to a length of #-9in (20-23cm), making un at least above the top had and a straight cut below the bottom bud



4 Space the cuttings in the trench about 4-6m (10-15cm) apart at the appropriate depth (see box below). Firm the soil well label and water Space adortional tows (2-15m (30-38cm) apart.

#### PLANTING DEPTHS



MULTISTEMMI D
ORNAMENTAL
AND FRUIT TREES
Insert each cutting
with the top onethird or 1~1 am
(2.5~3cm)
showing above the
surface of the soil



ORNAMENTAL
TREES
Cuttings should
be buried so that
the top bud of each
cutting sits just
below the surface
of the soil.

SINGLE-STEMMED



5 After several months, the cuttings should begin to root by the end of the following a wing season, sturdy new topgrowth should have developed



6 Lift the rooted cuttings after leaf fall in autumn, wrapping the roots in plastic to prevent drying out. Transplant the cuttings or pot them singly to grow on

the cuttings and replant them, spaced 12in (30cm) apart in rows 18in (45cm) apart, to grow on for another year

Another option is to root cuttings in containers. Insert three to five cuttings per pot into rooting medium (see p 34) after dipping the bases in hormone rooting compound. Label, water, and leave in a sheltered place, such as a cold frame. They should root by spring, pot them individually or in groups into larger containers.

#### HEEL CUTTINGS

Cuttings from woody plants were taken traditionally by pulling an appropriately sized shoot away from the main stem retaining a small sliver of bark, or heel, at the base. The heel contains high levels of growth hormones (auxins). These cuttings are still useful, especially for plants that have pithy stems, such as elder (Samburus), or plants that are old or in less than peak condition. They are not so effective with broadleaved trees. Heel cuttings may be taken from all types of wood, from hard- to softwood.

#### SEMI-RIPE CUTTINGS

This technique is suitable for rooting certain broadleaved evergreens, for example Magnolia grandiflora, Prunus tustanica, and hollies (liex), as well as many conifers (see p.70). The best time of year is usually late summer to early autumn, although cuttings may be taken in early summer or late autumn

Select material from the current season's growth that has parily ripened or hardened to take stem-tip cuttings as shown (right). If the semi-ripe shoot is long enough, several cuttings may be taken, take the lower cuttings with the basal cut just below a node and the top cut above a node. Alternatively, take heel cuttings (see above). If the leaves are large, cut them down. After treating them with hormone rooting compound insert the cuttings into pots, deep seed trays, or cell packs.

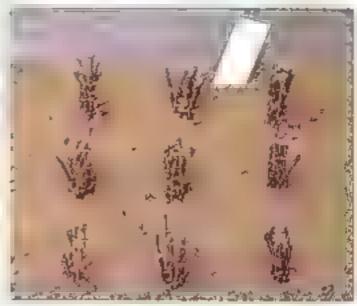
For the soil mix, use a free-draining medium such as a peat and bark mixture or other soilless mix (see p 34). Alternatively, use rockwool plugs or a bench bed of rooting medium in the greenhouse. Keep the cuttings humid and frost-free in a closed case or a cold frame, or under plastic. Bottom heat of 64–70°F (18–21°C) will aid rooting.

Periodically check the cuitings to ensure that the medium is sufficiently moist and the temperature is correct, as well as removing any dead leaves, which are potential sources of fungal infection Maintain high humidity by spraying the cuttings before covering them again Rooting usually occurs during autumn or winter; the cuttings may then be potted individually in spring

#### SLOW-ROOTING HARDWOOD CUTTINGS OF TREES



1 For tree species that do not mot easily, the the cuttings (here of Metasequoia) using garden twine into small bundles of up to ten cuttings. Dip the base of the cuttings in a small dish of hormone rooting powder or gel-

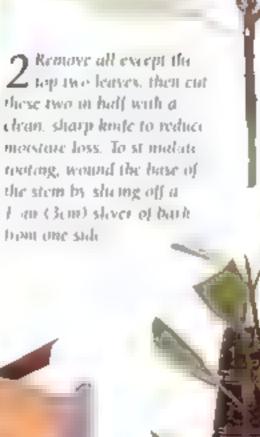


2 Insert the bundles into a sand hox or hed in a sheltered place or cold frame over winter. By spring, they should have rooted tiff the bundles and insert the cuttings singly in a prepared trench (see facing page

#### SEMI-RIPE CUTTINGS OF TREES

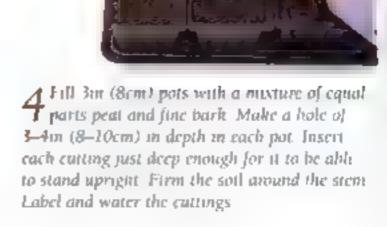


I Select a healthy show from the current seasons growth that is soft at the tip but firm at the base there of a magnolia? I sing pruners, cut straight above a node to obtain a cutting 4-6m (10-15cm) in length





3 Put a small amount of hormone rooting powder (or gel) into a saucer and dip the wounded stem into it. Tap the stem gently to remove any excess powder (see inset). Discard any remaining rooting compound from the dish when all the cuttings have been prepared.



#### SOFTWOOD CUTTINGS

Although less commonly used than hardwood or semi-ripe cuttings, this technique is suitable for raising various (primarily deciduous) trees, including some ornamental chernes (Prunus) as well as certain maples (Acer), birches Betula), and elms (Ulmus). Softwood cuttings are usually taken in late spring from the fast-growing tips of new shoots, and they typically root very easily. The shoots must be turgid, so the best time to take cuttings (see right) is early in the morning. They do dry out and will rapidly, however, so it is vital to prepare and insert them as quickly as possible after taking them from the parent plant

To save time, prepare the cells or pots before taking the cuttings. Use a free-draining rooting medium, such as equal parts fine bark or peat mixed with perlite or coarse sand. Firm the medium to just below the rim and water it. If using plug trays of rockwool (see p.35) soak them beforehand.

Take the cuttings by removing new, soft growth of the correct length at the junction of the new and old wood. Trim the stub from the parent shoot to avoid dieback. Even a small loss of moisture at this stage will hinder rooting, so put the cuttings in a partially inflated plastic bag (to minimize bruising) as you take them and seal, or immerse the cuttings in water If any cutting is longer than 4in (10cm), remove the growing tip; this

#### TAKING SOFTWOOD CUTTINGS



Remove 2-3in (5-8cm) long, soft shoot tips here of Betula utilis var jacquemontii) Cut straight across the union of the old and new wood. Keep the cuttings in a closed plastic bag from the bottom two leaves from each shoot.

diverts growth hormones to the base and aids rooting. Place at once in a closed case, plastic-film tent, or mist bench (see pp 38-44) to minimize moisture loss, with bottom heat of 64-75°F (18-24°C)

Check the cuttings regularly, remove any dead or diseased leaves, and spray with fungicide once a week. Rooting should occur in 6–10 weeks. Feed the cuttings regularly to ensure strong new topgrowth. Pot in the following spring and plant out after 2–3 years



then dip the base of the stems in hormone moting compound insert in cell packs in equal parts pent and perlite. Water (see inset) and label

#### GREENWOOD CUTTINGS

These cuttings are taken when the stems are slightly firmer and darker than for softwood cuttings. Take the cuttings between late spring and midsummer although cuttings in warm climates may root at other times of year. Prepare them as shown (see below) and keep under mist or in a high-humidaty tent. Once rooted, feed the cuttings regularly during the growing season, then pot them the following spring.

Soft wood removed

front tip of shoot

#### TAKING GREENWOOD CUTTINGS

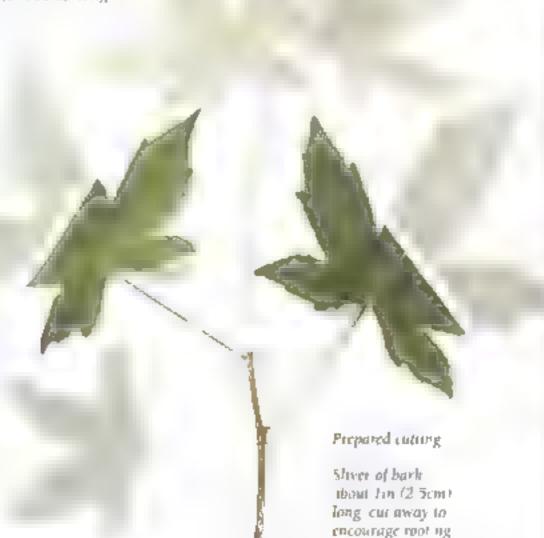


In early summer, cut across the union of old and new wood to take cuttings of 10-12m (2 × 30cm) in length from the current season's growth (here of Liquidambar)

2 off the soft wood at the tip of the shoot just above a node. Take off the bottom leaf and wound the base of the stem. A prepared cutting should be 3—tin (8–10cm) long with three nodes.

Larger leaves out in half to traface moisture loss





# SOWING SEEDS

Daising trees from seeds is generally IN straightforward and mexpensive and is useful for producing large numbers of plants, or rootstocks for subsequent grafting Seedlings often establish well and are unlikely to carry viruses from the parent plant. Seed-raised plants take 2-5 times as long as cuttings to attain flowering size, however, and may vary in appearance, hardiness, and growth It is impossible to predict the sex of new plants (vital for species that have foulsmelling fruits, such as Ginkgo biloba or in which only female plants have fruits, for example Ilex).

Success with tree seeds depends as much on the treatment of seeds before sowing as on the sowing method. Many seeds germinate more successfully if sown as soon as they ripen, but purchased seeds are adequate if stored correctly. Some seeds, especially those of the northern temperate regions, must be treated to break their natural

dormancy before sowing

COLLECTING AND CLEANING SEEDS

Both dry and fleshy fruits may be picked by hand (taking care not to damage the parent plant). Preparation depends. on the type of seeds. Those that ripen in spring or summer, such as poplar (Populus) and willow (Salix), require little cleaning other than teasing apart the seedhead

Pops Spread out pods of trees such as Cercis, Laburnum, or Robinia in a warm room in a paper bag or with newspaper over them. The pods will split open after a few days and shed the seeds.

WINGED SEEDS. The wings of seeds such as of ash (Fraxinus) or maples (Acer) may be left on the seeds or cut or rubbed off for ease of handling

NUTS Remove the outer husks from nuts such as those of beech (Fagus), hazel (Corylas), and chestnut (Castanea), but preserve the shells

#### FRUITS AND SEEDPODS

frees develop different fruiting bodies, which protect unfertilized seeds and aid dispersal of ripe seeds. Most mees have fleshy Junis to tempt animals to eat them, dry seedheads to scatter seeds on the wind, or hard-shelled muts to stop ununals from eating them. Cones

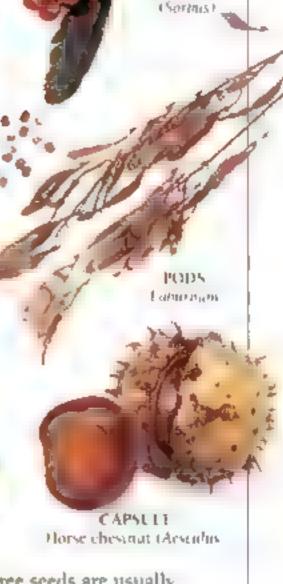


COME Patte Plates!



STONE FRUIT

WENGED SIED Maple (Ace)



BI RRIES

Mountain ash

CATRINS Collect cathers from trees such as alder (Alnus) while still green before they ripen and keep in paper bags for a week or two until they disintegrate FLESHY FRUITS. With large fruits such as apples (Malus) and pears (Pyrus), cut open the fruits and remove the seeds Pulp smaller fruits and leave in warm water for up to four days to separate out the seeds (see below), which should sink to the bottom. Dish detergent added to the water may assist separation. Once the seeds are clean, pat them dry CONES Dry ripe cones in a warm place to release the seeds (see Comfers, p 71)

#### STORING TREE SEEDS

It is important to store seeds correctly to preserve their viability until you can sow them Remove damaged or shriveled seeds before storing - they are hable to

be diseased. Tree seeds are usually stored at 37°F (3°C) in a refrigerator (not a freezer) Most are refrigerated dry, to avoid the risk of fungal disease or rot. in sealed and labeled plastic bags. Seeds from fleshy fruits are only surface-dried Large seeds, such as walnuts (Juglans) and oaks (Quercus), and only seeds, such as magnolias, cannot take up water once they dry out and so will not germinate Store these seeds in a plastic bag of moist vermiculite or sand or in a mix of moist peat and sand (see below).

#### OVERCOMING SEED DORMANCY

In nature, dormancy ensures that seeds do not germinate before the onset of spring, but it can inhibit germination even in good conditions. There are various ways to overcome dormancy, the first is scarification (continued on p.54)

#### EXTRACTING SEEDS FROM FLESHY FRUITS



Put the fruits (here Sorbus) in L a sieve and hold under rooming water Squash them with your chamb until they are well mashed.



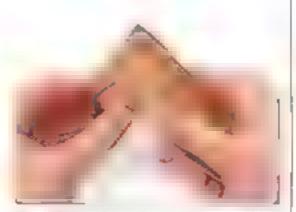
Put the fruit pulp in a jar and Itill with water, Allow to settle Drain the contents through a sieve Viable seeds should stay in the jar

#### STORING TREE SEEDS

#### SCARIFYING SEEDS



Certain seeds must not be allowed to dry out Store mixed with moist peat and coarse sand in a clear plastic bag in the refrigerator.



Scarify seeds with an impermeable coating to speed germination Abrade part of the seed coat to allow morsture to get in.

Continued from p.53.) Tree seeds such as Acacia and Robinia with very hard seed coats must be abraded or scarified to let water into the seed. Use sandpaper (see p.53) or a file, gently crack the seed coat using a nutcracker, or nick it with a sharp knife. You can also carefully burn a small hole in the seed with a soldering iron

Soften hard seed coats by soaking in hot (not boiling) water for up to 48 hours, depending on the size of the seeds. Sow seeds directly after soaking if allowed to dry out again, they will die

Some trees, for example hawthorns (Crataegus), lindens (Tilia), and mountain ashes (Sorbus), develop germination inhibitors in the seeds as they ripen. Gather seeds when they are mature but not fully ripe, before the inhibitors develop, to ensure good germination. Clean and store the seeds as usual and sow them in spring

Other tree seeds have a physiological (or embryo) dormancy, sensitive to certain levels of cold and heat. Such

seeds are treated by stratification, of which there are two types.

COLD MOIST STRATIFICATION. This is the most common technique, especially for hardy trees, and involves chilling seeds to mimic the passing of winter, they also must be kept moist so that the seeds can start to respire. Traditionally, seeds in cold climates were sown in autumn to overwinter in containers in a cold frame or in an open seedbed. Germination varied depending on local conditions, with a low success rate following a mild winter. Chilling seeds in a refrigerator at  $3+-41^{\circ}F(1-5^{\circ}C)$ , usually at  $37^{\circ}F(3^{\circ}C)$ has the advantage that you can provide a cold period at any time of year and expect a more even germination

To chill small numbers of seeds soak them in water for 48 hours, allow to drain, then refrigerate in a labeled and scaled plastic bag for 4–20 weeks before sowing. Twelve weeks is the average, but it depends on the species (see A–Z of Garden Trees, pp.74–91)

For large quantities, store the seeds in a plastic bag filled with peat or a mixture of equal parts peat and coarse sand or vermiculite. This should be moist, not wet. Periodically turn the bag to circulate air and avoid a buildup of warmth or carbon droxide released by the seeds If the seeds germinate in the bag prematurely, sow them at once WARM MOIST STRATIFICATION Some seeds. such as ash (Fraxinus) or Davidia, are doubly dormant and germinate naturally after 18 months, or in the second spring, after ripening, with only a few seeds germinating in the first spring. If freshly collected seeds are exposed to a spell of warmth to simulate summer ripening. followed by a cold period, they should all germinate during the first spring. Place the seeds in a plastic bag, as for cold stratification, and keep them warm for up to 12 weeks at 64-75°F (18-24°C), then cold stratify them in the refrigerator Alternatively, sow the ripe seeds in containers, then keep them warm at

#### SOWING TREE SELDS IN CONTAINERS



It all a 3m (8cm) pot with seed soft mix, and from it gently to about our (1cm) below the rim of the pot. Sow larger seeds (here of Betula singly, spacing them evenly over the surface Broadcast-sow fine seeds



2 for large seeds, sieve seed soft mix over the seeds until they are just covered to their own depth with mix. Cover fine seeds with a very light dusting of mix or a thin layer of fine gett or fine-grade vermicolite.



3 Cover the soil our with a son Committanes of small gravel. Label and water well, using a fine-rosed watering can. Leave the pot in a sheltered place – usually in a cold frame, closed case, or heated greenhouse.



4 Keep temperate species at 54–59% (12–15°C) and warm-temperate and tropical species at 70°F (21°C). The seeds should germinate and the seedlings grow to 1–2m (2.5–5cm) in height within 6–8 weeks



5 Knock the seedlings out of their pot. The soil mix should break in making it easier to tease out the roots. Always hold the seedlings by their leaves, since their roots and stems are very fragile and are easily damaged.



6 Transplant each seeding individually in a 3in (8cm) pot filled with soilless potting max. Firm gently around the seeding, label and water. Grow on in the same place as before Harden them off gradually after 3-4 weeks.

#### SOWING LARGE SEEDS



I seedings with long taproots that produce the seedings with long taproots that each individually in 400 (1000) deep pois. Press each seed into untirmed, soil hased seed mex. Cover the seed to its own depth with more nex to son (5000) below the potential.

the same temperature in a heated closed case before exposing them to a period of winter cold outdoors.

#### SOWING TREE SEEDS IN CONTAINERS

This is the most widely practiced means of seed-raising because it allows more control over environmental conditions and pests than when sowing direct outdoors and generally gives a higher success tate in raising healthy seedlings.

There are many suitable containers including standard pots, seed trays for large numbers of seeds, and specialized containers such as root-trainers or deep pots (see above) for taprooted trees such as oaks (Quercus) and Eucalyptus

In general, a free-drawing, mildly acidic, soilless mix is used (see p 34) For lime-hating trees such as Arbutus menzicsu, use an acidic seed soil mix. Seeds that germinate slowly (12 months of more) are best sown in a heavier, soil-based seed mix. Sow the seeds as shown (see facing page). Usually the seeds are covered with fine grit or small gravel to prevent "capping," or a crust forming on the surface, and to avoid growth of mosses or liverworts, but if germination is likely to be very rapid, use vermiculite instead.

Place the containers in a sheltered place at an appropriate temperature (see facing page). A night minimum of 50°F (10°C) is generally sufficient under cover. For some tender species, however 59–68°F (15–20°C) is preferable. Always keep seeds for at least a year if they do not germinate in the first year – they may come up during the second spring

Once germination occurs, transplant the seedlings as soon as they are large knough to handle by the leaves, then return them to where they were before After hardening off the seedlings (see p.45), pot them on or line them out in a nursery bed. Seedlings raised in root2 After sowing water
2 and label the por
Place in a sheltered place
such as a cold frame or in
a closed case under cover
fly using a deep pot for
such seedlings, the taproot
can develop without any
testriction (see inser

trainers (because they dislike root disturbance) should be planted into their final locations as soon as possible

#### SOWING THEE SEFDS IN A SEEDBED

If there are no facilities under cover or if it is difficult to provide full aftercare for seedlings, you may choose to sow direct outdoors. Protect the site from wind if possible, with a hedge or artificial wind break. The seedbed must be free of weeds, prepare the soil in the preceding spring and summer so that you can hoe off any weed seedlings. Incorporating well-roited leaf mold at this stage also helps; it usually contains mycorrhizae, soil-borne fungi that help seedling growth and improve soil structure. Cultivate the bed to one spit (spades blade) deep. Raise the seedbed as shown below, by boarding around the margins or hilling up the soil. This creates as even-textured and as well-drained a soil structure as possible to aid germination.

Before sowing (in early to midspring or, in cold climates for seeds that require a cold period, in mid- to late autumn), rake over the soil surface, remove any large stones, and tread evenly over the bed to firm the soil

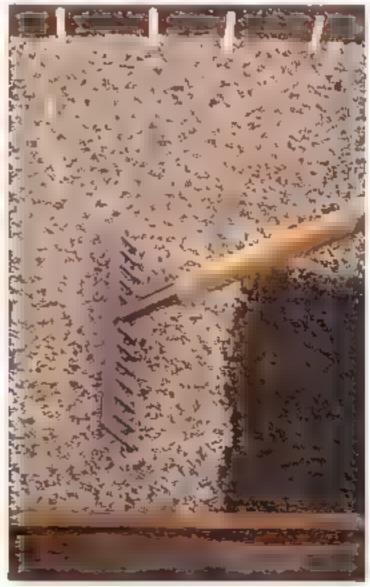
Many tree seeds are fairly large and can be space-sown, either in drills (so below) or in individual holes. Small seeds are sown in drills. Always sow seeds at the correct depth, aim to cover the seeds by roughly twice their own diameter. Large seeds should be sown at least 2–3m (5–8cm) deep

Make drills using a draw hoe, the tip of a stake, or by pressing a board into the soil. To reduce the risk of fungal attack, sow small seeds thinly directly from the packet or by taking a pinch of seeds and running it along the drill. Cover the seeds as shown. If necessary, thin the seedlings to 2m (5cm) apart, Transplant into a nursery bed after a year to grow on, and keep them fed and well watered.

#### SOWING TREE SEEDS IN A SEEDBILD



Prepare a raised seedbed, 4-8in (10-20cm) deep and 3ft (1m) wide Make drills 4-6in (10-15cm) apart with a hoe Space-son the seeds 14-3in (3-8cm) apart, keeping one type of seed in each drill Label each drill



2 Cover the seeds lightly with soil by drawing it over with the back of a rake Rake a sin m) deep layer of fine gravel over the entire but Atlan the sections to grow on for up to a year until they are ready to transplant

# GRAFTING AND BUDDING

Grafting has acquired an undeserved mystique, probably because it is largely used by commercial growers, but there is no reason for home gardeners not to try it. Once you understand the basic principles, and with a hitle practice and confidence with specific techniques you should be able to graft successfully.

Grafting involves uniting parts of two separate plants to combine some of the benefits of each the root system or rootstock, of one, and a portion of stem from the plant to be propagated known as the scion, which forms the plant's topgrowth. Grafted plants unlike cuttings, have the advantage of an arready-formed root system, so they establish relatively quickly and are usually ready for planting out in 2–3 years

In some cases, the rootstock confers a valuable quality such as disease resistance or restricted size (useful for fruit trees which otherwise grow too tall to harvest easily). Certain trees, for example apples (Malus) and fruiting and ornamental cherries (Prunus), grow less well and

produce smaller crops when grown on their own roots than when they are grafted. Stocks and scions must be compatible, usually of the same genus and often derived from the same species.

OBTAINING ROOTSTOCKS FOR GRAFTING Good quality rootstocks are essential to produce good-quality trees. You may be able to buy stocks, usually from speciality nurseries, but it is better to raise your own — you can then use as many stocks as you need and can be sure of them being the correct size. If buying fruit stocks, try to obtain virusfree certified stocks wherever possible and make sure that you obtain the correct stock for the type and size of tree you want to grow (see A–Z of Garden Trees for details, pp.74–91)

Rootstocks should be well rooted and straight, of medium thickness for the plant and about 18m (45cm) tall. Plant them while dormant in well-prepared soil, this should be free-draining enriched with well-rotted manure, and

free from perennial weeds. Add a general slow-release fertilizer at a rate according to the manufacturer's instructions

Ornamental stocks are usually raised from seeds, such as Norway maple (Acer platanoides), bird cherry (Prunus avium), hawthorn (Crataegus monogyna), black locust (Robinia pseudocacacia), European beech (Fagus sylvatica), and mountain ash (Sorbus aucuparia) Fruit-tree stocks, flowering crabapples, certain ornamental plums, and hazels (Corylus) are better obtained by stooling (see below) or trench layering (see facing page), these are called clonal rootstocks because they are identical to the parent

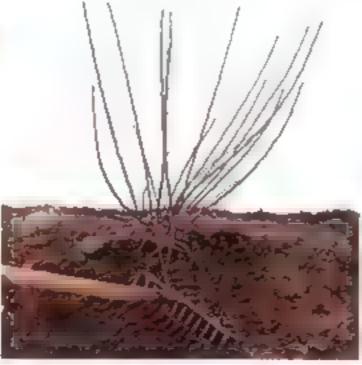
#### ROOTSTOCKS FROM STOOLING

The principal technique in this form of layering, shown below, involves hilling up an easily rooted, usually two-year-old parent plant to stimulate rooting at the base of the stems. The parent plant is cut back hard (see box, below) before hilling up to obtain as many new shoots as possible

#### GROWING ROOTSTOCKS BY STOOLING

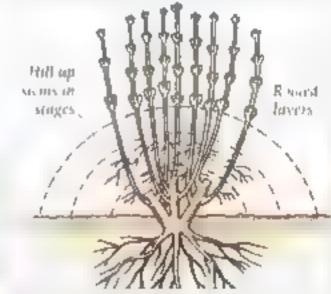


I Select a healthy 1-2-year-old stock plant chere, apple) with plenty of shoats. Half up the base of the stems in stages from spring to late summer. Each time first lightly and water

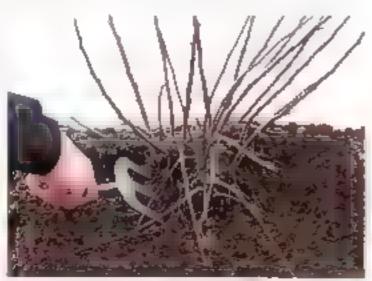


2 Throughout the growing season, keep the sent around the stock plant moist to encourage rooting from the lower stems. In late autumn, carefully rake away the soil mound.

#### STOOLING A STOCK PLANT



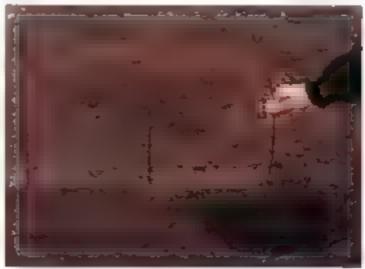
To obtain lots of young shoots, cut back the stock plant to 3in (8cm) in late winter of early spring. Begin hilling up (see step 1) when the new shoots are 6in (15cm) long



3 With a hand fork, carefully tease out the soil from around the roots to expose the new roots growing from the bases of the hilled up stems. Take care not to damage the roots



4 Remove moted shoots from the stock plant Use sharp primers to make a straight cut just above the neck of the parent plant Recover the roots of the plant with 2m (5cm) of soil



5 Dig a straight backed trench in a nursery bed and line out the moted layers 9in (23cm, deep and 12-18in (30-45cm) apart. Label and water well. Grow on to use as motstocks

3 Cut off the layered stems at the base of

#### TRENCH LAYERING

In the dormant season, plant the parent stack at an angle in a nursery bea. The next winter, dig a trench along the row Peg each shoot to the trench base. Cover with friable soil. Hal up new sideshoots in stages as they grow, over spring and simmer.



Parent planted

at 45 angle

2 the following winter carefully remove the hilled-up soil to reveal the adventitions roots at the base of each sideshoot, or layer

Shehow treach, 2 n Shoots pinned (Sem) deep in per non

Once rooted, these shoots, or lavers, may be cut off the parent and hined out in a trench to grow on (see step 5, facing page), ready for subsequent grafting. It is important to plant the lavers quite deeply in the trench so that the young rootstocks produce shoots that are as straight as possible as well as have good

growing a large number of stocks, space the rows 3ft (90cm) apart and orient them north to south to minimize shade

After planting, lightly prune any weak growth and remove any sideshoots below about 12m (30cm) flush with the stem, in order to leave a clean stem for budding and grafting (see pp 58–63). During summer, rub out any sideshoots that appear below about 12m (30cm)

The young stocks must make active growth for budding and grafting to succeed, so good irrigation is important he most effective and economical method is to lay a drip line or a seep hose (see p.44) along each row of stocks

ROOTSTOCKS FROM TRENCH LAYERING

This method (also known as "etiolation layering) is used for fruit trees including apples (Malus), pears (Pyrus), chernes and peaches (Prunus), walnuts (Juglans), mulberries (Morus), and quinces (Cydonia oblonga). The technique works on the principle that shoots produce roots more easily when they are pale and drawn (etiolated). Two-year-old parent plants are planted at an angle (see above) in autumn; they should be spaced in rows 5ft (1.5m) apart at 2ft (60cm) intervals to allow room for hilling up

In the following late winter, make a shallow trench along the row of plants, then peg down the young shoots, using wooden pegs or staples of heavy wire into the bottom of the trench. Cut back weak sideshoots, but leave strong ones unpruned or just lightly tip them back. All the sideshoots must be pegged down.

flat or removed entirely. Fill in the trench with friable soil or compost

As new sideshoots push through the soil in spring, they become etiolated. Once they appear, hill up the shoots with another lin (2.5cm) layer of soil use fresh soil or compost to reduce the risk of disease. Repeat this process twice or three times more in the early part of the growing season, and as needed throughout the season, until the plants are hilled up to a height of 6-8im (15-20cm). Take care to keep the soil moist during this time to encourage the shoots to root into the soil

In the following late winter, uncover and sever rooted shoots (see above) Select new shoots near the base of the plant. Repeat the process as required



# the plant. Cut each stem r to sections, each with a sideshoot and a developing root system. Discard the remainder of the stem. I the out the rooted layers to grow on as for steoling, see facing page.) Observat remnants of old stems.

from side shoor

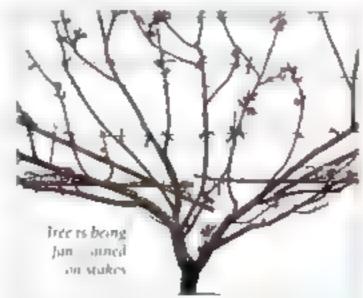
PEST AND DISEASE CONTROL

In general, rootstocks are susceptible to the same pests and diseases as the scion cultivats, although some have a degree of resistance – for example, one of the main stocks for grafting citrus trees, the Japanese bitter orange (Poncirus trifohata), resists phytophthora root disease it is vital to keep stocks well fed and watered to increase their resistance and to control any problems, ensuring active growth of the stock and reducing the risk of infection to the scion cultivar

Apple and quince stocks are usually susceptible to apple powdery mildew, particularly if they are not well watered. Check for and control aphids, especially on stone-fruit stocks, because the insects transmit virus diseases.

#### GRAFTING MULTIPLE SCIONS

In some cases, you may want to graft more than one scion onto a stock. For fruit trees creating a multiple tree using scions from two or three different cultivars provides a choice of fruit on a single tree (for example both cooking and eating apples, or peaches



Mr LTIPLE TREE Fruit-tree motstocks can have scions from two or more related cultivars grafted onto them. Here, cultivars of a nectarine (left-hand side) and a peach (righthand side) are budded onto a Prunus stock

and nectarines, as below) or may be done to aid cross-fertilization. For ornamental trees, using multiple scions helps create a more balanced crown. It is especially valuable for a weeping tree, using scions of naturally pendent forms grafted onto a tall stem.



IOP-WORKING Two
scions of Sahx caprea
Kilmarnock have
been whip-and-tongue
grafted (see inset and
p 59) onto a rootstock
of S. x stipularis
to produce a more
balanced canopy than
would be achieved
with only one scion

#### SPLICED SIDE GRAFTING



I for the scions, gather strong ne year-old stems and trim each one down to 6-10m 15-25cm; cutting just above a bid or pair of bids. Refrigerate in a plastic bag until ready to graft.



2 To graft, make a short, down with mick about 1 in (2 5cm below the top of each stock. Then, starting near the top of the stock make a sloping, downward cut to meet the inner point of the first cut



3 Remove the sliver of wood Make the financial overting straight up to a he must correct of the first cut. This creates a flat when the tree theolow with a shoulder at the base

6 to prevent the graft from tosting moisture and failing.

brush a layer of wound scatant

or grafting was over all the

external cut surfaces on both

the stock and the scion



of South as life

r mr ends

A successful graft should "take worth a few weeks, when the buds of the seron walt show signs of growth. If any suckers appear on the stock remove them, or they waldivert growth away from the seron



4 to prepare the secon, make a shallow, sloping cut about 1m (2.5cm) long down to the base then make a short, angled cut at the base of the secon from the opposite side (see inset)



5 immediately fit the base of traset inset? so that the cambrians meet Bind the graft with some grafting tupe (or raffia) until a is completely covered

#### SPLICED SIDE GRAFTING

This is usually carried out just before bud break in late winter or early spring and is useful if the stock is thicker than the scion. Two-year-old, seed-raised stocks are most often used, it is essential that they have straight stems and a good root system in an 3—Im (8–10cm) pot A potbound plant cannot support a graft Bring the stocks into a cool greenhouse with a nighttime minimum of 45–50°F (7–10°C) 2–3 weeks before grafting Keep on the dry side to avoid excessive sap flow, which hinders union of a graft

Collect scions from the tree to be propagated, choosing healthy, vigorous, one-year-old shoots. Remove them by cutting into the two-year-old wood to retain the union between new and old wood (scions graft more successfully if they have older wood at the base). Keep the scions fresh in a plastic bag in a refrigerator until you are ready to graft.

Head back the stock to 3—4m (8–10cm) above the base; cut as shown above. Take a scion, frim the base at the union of the new and old wood, then remove the top buds so that the scion is 6–10m (15–25cm) long. Cut the base of the scion to match the cut on the stock, ensuring that a dormant bud is retained opposite the cut. Position the base of the

scion in the cut on the stock and secure with grafting tape of raffia. Seal any exposed cut surfaces and label the plant

#### WHIP GRAFTING

This is used if the stock and scion are exactly the same diameter, as for spliced side grafting, but with a simpler cut. This slanting, downward cut, 1–2in (2.5–5cm) long, starts at one side of the top of the stock and ends on the opposite side of the stem. Cut the scion to match and proceed as for spliced side grafting.

#### APICAL-WEDGE GRAFTING

This is similar to spliced side grafting, but the scions are only 6in (15cm) long. Cut down into the stock across the center to a depth of 1–2in (2.5–5cm). Thin the base of the scion into a V-shape, making a 2in (5cm) slanting cut on each side. Push the base of the scion into the stock. The top, or "church window," of both cuts on the scion should be visible above the stock. Treat thereafter as for spliced side grafting.

#### SPLICED SIDE-VENEER GRAFTING

With trees that are difficult to unite with a stock or have thin bark, such as Japanese maples (Acer), the stock is headed back only once the graft has

#### **GRAFTING TECHNIQUES**

The principles of grafting are largely the same, regardless of method, but different techniques are used according to the plant being grafted and the relative sizes of rootstock and scion (for details of specific plants, see A–Z of Garden Trees, pp.74–91) Most grafting is done in late winter to early spring or in mid- to late summer. Ornamentals are often grafted onto containerized stocks under cover , bench grafting) where it is easier to control conditions, whereas fruit trees are usually budded or grafted outdoors (field budding or grafting) onto stocks or trees in open ground

For a graft to succeed, it is vital that the cambiums (thin regenerative layers just below the bark) of stock and scion are in close contact and that the graft does not dry out or become infected before it "takes" and calluses. The cuts therefore must be as precise as possible practice first on willow stems. Make one graft at a time, use a clean, sharp knife, and work as quickly as possible to prevent the cuts from drying out. Avoid touching the cut surfaces, and ensure the cambiums align before sealing the graft.

In warm, humid climates, scions may be taken up to 12in (30cm) in length, they will take and mature more quickly taken. Consfers are also grafted in this way. This graft is done just before bud break or in mid- to late summer. If the latter, collect scions early in the morning from ripe wood of the current seasons growth, cutting into old wood as before. Prepare the scion otherwise as for a spliced side graft. Trim off leaves from the bottom fin (15cm) of the stock. then graft as for consfers (see p.73).

Once the graft has taken, the top of the stock above the union is gradually headed back. How quickly you do this depends on the plant being grafted (see A-Z of Garden Trees, pp. 74-91). In the first 12 months after grafting, the stock is used as a support for the scion, which is loosely fied to it. By the second spring after grafting, the stock should have been headed back completely

**CARING FOR BENCH-GRAFTED PLANTS** 

For grafts carried out in late winter or early spring, in cold climates, line out the plants on the bench in a cool greenhouse with a nighttime minimum of 50°F (10°C), if possible, apply bottom heat of 59–64°F (15–18°C) to encourage the rootstock into growth before the scion. Alternatively, place the grafts in

a hot pipe to encourage them to callus (see p. 109). Remove any suckers as soon as they appear on the rootstock. Pot the plants in late spring or early summer

In warm climates or with summergrafted plants that may lose moisture through their leaves, keep them in high humidity, in a closed case or plastic-film tent, at a nighttime minimum of 59°F (15°C). Each day, check for fungal disease and mist-spray to keep up the humidity. Keep the rootstocks on the dry side until callusing of the graft and shoot growth is evident, then wean the plants off the humidity 6–8 weeks later Keep them cool but frost-free for the first winter, then pot on in spring

#### WHIP-AND-TONGUE GRAFTING

This is a very common method of field grafting, widely used for fruit trees and for some ornamentals, where the larger root system of the rootstock results in a superior tree. It may also be used on plants where budding (see pp 60–62) has failed, the plant is grafted in spring following the attempted budding to obtain a tree in the same length of time. This graft is most suitable when stock and scion are of a similar diameter, not

more than 1in (2.5cm), for a neat union Use established rootstocks (usually planted at least 12 months in advance)

Gather scions, as shown below, of roughly pencil thickness from dormant trees, when the growth hormones are concentrated at the buds. Heel them in (see below) or keep in a dry plastic bag in a refrigerator. In early spring, prepare the stocks and scions with matching cuts, then fit together. If the cut on the stock is much wider than that on the scion, place the scion off center so there is good cambial contact on at least one side. If the cut is large, cover it, as well as the "church window" on the scion, with grafting wax to prevent moisture loss and to keep water from entering the graft, which may make it fail. The graft should callus after six weeks or so

One or all three buds on the scion should grow out. Choose one to grow on to form the tree (usually the topmost one), you will probably need to tie it to a stake to ensure that it grows straight. Cut back any others once they have three or four leaves. Remove any side-shoots from below the graft union once they are 3-4in (8-10cm) long (they are useful to feed the stock until then)

#### WHIP-AND-TONGLE GRAFTING



I Select healthy, vigorous hardwood shoots of the previous season's growth from the secon tree in late winter. Use primers to take lengths of about 9in (23cm eating obtiquely first above a bud



2 More mondoes of five or six scions. Prepare a sheltered free-draming six and heel them in toward. Sin 5-8cm) above the soil suctace. This will been them more a bid dormant until grafting



3 Prepare each stock just before but but break in early spring Cut off the top, about 6-12in (15-30cm) above ground level. Trim off any sideshoots. Make a 17m (3.5cm upward-sloping cut on one side



4 Make a shallow the sion, about in (5mm) deep, approximately one third of the way down the exposed cambium (ayer of the stock flits forms a tongue (see tinset) to tink into a similar one on the scion



5 Lift the scion Cut off any soft growth at the tip. Trim to three or four buds. Choose a bud I Ain (3.5cm) from the base, remove a slice of wood on the opposite side, cutting from the bud to the base



6 Match the tongue on the stock by making a similar slit into the cambium layer on the scion (see inset). Take care not to touch and contaminate any of the cut surfaces with your hands



That on the stock (top inset)

I se the arches of the cambium
layer (see bottom inset) to guide
you and adjust the scion until the
cambiums fit well together.



8 When the two cambium tavers are in close contact bind the scion and stock firmly together with grafting tope or raffia. Remove the tape when a cattus forms around the graft union (see inset)

#### CHIP BUDDING: PREPARING THE SCION



In midsummer select a vigorous, ripered shoot (here of apple) of the current seasons would The shoot or bidstick, should be of pencil thickness and have well-developed bids.



2 I se a clean, sharp house to trum off all the leaves from the hudstick, leaving a san (3-4mm) stub of each least stalk (petiole) have the soft tip from the top of the shoot





For container-grown ornamental trees, when removing the leaves from the budstick (hen of a magnolia), cut through each leaf stalk to teave a 1-1 in (2-2 5 cm) stab. Remove each bud chip as shown in steps 3-5, below



3 Select the first bud at the base of the budst is K. Cut into the stem about on 2 m below the bud to a depth of san (5mm), angling the knde blade downward at an angle of 30°



4 Make another incision about 1 in (4cm)
above the first Slice downward belond the
had toward the first cut. The bad chip should
then come away from the badstick (see inset)



5 The bud chip (see ornamental bud chip meet) consists of a dormant bud, trin mea leaf stalk, and slice of wood. Holding the bud chip by the leaf stalk, put it in a plastic bug

#### BUDDING TREES

Budding, also known as bud-grafting employs similar principles to grafting (see p 58), except that the scion consists of a single growth bud rather than a length of stem. There are two main techniques, chip-budding (see above) and T-budding, or shield budding (see p 62). Both are extensively used by commercial growers, especially for fruit trees, but they are also well within the capabilities of the avid gardener. Any tree that may be whip-and-tongue grafted (see p.59) may be budded (see also A-Z of Garden Trees, pp 74-91).

#### CHIP-BUDDING FRUIT TREES

This is the most successful technique for grafting fruit trees. Although a very old method, it has only in recent years become widely used. It has an advantage over T-budding in that it can be carried out over a longer period of the year, although it is usually done between midsummer and early autumn

For best results, use healthy, virusfree rootstocks and virus-free scion wood if possible (usually available for only a few cultivars that are mainly grown commercially). For the scion material, or budsticks, select pencil-thick shoots of well-ripened new growth where the base of the shoot is starting to turn brown and woody. It is best to take shoots from the periphery of the tree, usually on the sunny side Avoid weak, green, etiolated shoots. The shoots must not dry out, so place them in a bucket of water immediately.

Prepare a budstick by removing the leaf blades, as shown above, to leave short leaf stalks (petioles). Also remove the stipules (leaflike structures at the bases of leaf stalks) to minimize any water loss, and any immature, unripe growth toward the tip of the shoot

If budding a large number of plants and preparing several budsticks, keep them wrapped in a damp cloth until ready to use, and graft one bud at a time. Work from the base of the budstick to select the first bud. Avoid any large, prominent buds that may be fruit buds. With stone fruits such as chernes or peaches, check that the buds are small, pointed leaf buds, not

large, round fruit buds. Holding the budstick firmly, make a cut below the bud at an angle of about 30° (see above). Make another incision above the first and slice downward behind the bud toward the first incision. Remove the bud chip, holding it carefully by the leaf stalk so as not to touch and contaminate the exposed cambium layer.

Prepare each rootstock by removing sideshoots and leaves from the lower main stem (see facing page). Select an area of clean, smooth stem at a height of 6–12m (15–30cm) above ground level (preferably on the shady side of the stock). Remove a piece of wood from the stock. Make the first cut just above a node to prevent the knife from slipping, then tailor the cut as closely to the size and shape of the bud chip as possible to ensure a close match of the cambiums.

Position the bud chip on the stock making sure that the cambiums meet, place it off center if necessary to ensure good cambial contact on at least one side Bind the bud chip to the stock with grafting tape or 1 in (2.5cm) budding tape. Tuck in one end of the tape below

the bud, then bind around and over the bud to avoid the wind drying it (or around the bud, only if it is very large)

Once the bud unites with the stock you should notice a callus forming around the edges. If the bud has taken successfully, the leaf stalk will look plump and healthy and should drop off at or before leaf fall, if so, you may then remove the tape. If the bud has not taken, however, the leaf stalk will wither and turn brown and will not fall off. If the bud fails, leave the stock until the following early spring, cut back the stock to below the failed bud, and whip-and-tongue graft it instead (see p.59).

CARE OF CHIP-BUDDED FRUIT TREES In the following late winter or early spring, when the buds of the rootstock start into growth, cut back the stock to just above the bud, (see below)

As the bud shoot develops and grows out, shoots should also grow out from the stock below the bud. Remove these

when they are about 3—4in (8—10cm) long and the bud shoot is growing strongly (before this they are needed to feed the stock). If the bud shoot does not grow straight, tie it to a stake to support it, but leave it unsupported otherwise. Any flowers produced by the bud should be removed, so that all the nutrients go into the developing shoot.

During the following autumn, the tree should be ready to plant out in its final position or, if required, transplanted for further training into a nursery bed

Chip-Budding ornamental trees, including crabapples (Malus), hawthorns (Cratacgus), Laburaum, magnohas, and Sorbus, as well as ornamental cherries (Prunus) and pears (Pyrus), may be propagated successfully by chip-budding. For those that are field-budded, the procedures are identical to those used for fruit trees.

Some ornamental trees (see A–Z of Garden Trees, pp 74–91) may be budded

in a cool greenhouse using containergrown stocks. The technique is similar
to field-budding and is carried out in
mid-to late summer. The budsticks
are prepared in a slightly different way,
however (see box, facing page), budding
is carried out at about 2in (5cm) above
the base of the stem. The bud and leaf
stalk are also left exposed (see box,
below) because they do not need to be
covered with grafting tape to stop them
from drying out, as in field budding

In 10–14 days, the leaf stalk should tall off if the bud has taken successfully. Leave the grafting tape in place until the bud is growing strongly, then cut back the stock to just above the developing bud to channel energy into the bud. By the end of autumn, some shoot growth should be evident. Keep the plants frost-free over the winter. Pot them on in spring and cut back again to promote bushy growth. The budded trees should be ready to plant in their permanent positions in 6–12 months.

#### CHIP-BUDDING: UNITING THE SCION AND STOCK



I to prepare the rootstock

I stand astride the plant
Remove all the sidesh rots and
leaves from the bottom 12m

10cm) of the stan as as, a
clean sharp lonfe



2 Select an aird of clean smooth stem. Make a shallow cut just above a node Remove a sliver of back to reveal the cambiam (see inset) and leave a hip at the base.



3 Place the bud chip in position on the stock (see inset). If the cut on the stock is wider than the bud chip to the Bina around and over the bud is wider than the bud chip conce the chip to one side so that the candhum tayers meet.

4 Bind the bud chip to the around and over the bud is carefully remove the tape once the bud chip unites with the stock (usually in 6-8 weeks).





Prepare a container-grown rootstock by removing all the leaves from the bottom 10–12in (25–30cm) of the stem, using a sharp knife



Bind the bud chip securely to the stock, but leave both the bud and the leaf stalk exposed. The leaf stalk will drop off in 10–14 days if the bud takes



PRUNING A CHIP-BL DDED TREE
In the following late winter or early spring,
remove the top of the stock. Use pruners to cut
just above the grafted bud, using an angled cut
isee inset). During the spring and summer, a
shoot from the grafted bud will develop (above)

#### T BUDDING TREES



I take a ripened shoot from current season's growth on the secon plant and strip off the leaves. Cut a healthy bud from the secon, with a strip of back extending roughly lan (2.5cm) above and below the bud. Remove the silver of wood behind the back.

#### T-BUDDING TREES

This is the most widely used technique worldwide for grafting fruit trees, as well as for some ornamentals, for example magnolias, and may also be used to create a standard tree. Although it is effective, its popularity may soon be overtaken by chip-budding (which has proved to be easier and more successful and is now more widely practiced, see p.60). Its name derives from the T-shaped cut that is made on the rootstock into which the bud is inserted. It is also known as shield budding because the bud is taken with a piece of bark, like a small shield.

The principal drawback of T-budding is that it can be carried out only when the bark of the stock lifts easily away from the wood, usually in summer. Drought impedes this, so in dry weather prepare the stocks by keeping them well watered for up to two weeks before T-budding. The T-bud is more fragile than a chip bud because the wood is not retained. In addition, there is a greater risk of infection by airborne fungal diseases, particularly apple canker, which can be inoculated below the bark on the bud shield.

However, T-budding is a well-proven technique, and some people find it easier than chip-budding. (See A–Z of Garden Trees, pp.74–91, for suitable trees.)

As with chip-budding and whip-andtongue grafting (see p.59), use healthy, virus-free rootstocks whenever possible and, if available, virus-free scion wood As for chip-budding, the stocks should be at least two years old and planted out in the autumn before I budding

PREPARING THE STOCK AND SCION Collect the scion material from the plant you wish to propagate in the same way as for chip-budding (see p 60), selecting ripened shoots from the current seasons growth. The preparation of the budstick is slightly different, however. Strip off

the leaves, but leave a fairly long leaf



2 bour 6-12m (15-30cm) above ground level, make a T-shaped cut in the bark of the stock. With the reverse blade of the kinfe anchory proclass k the flaps of bark to expose the path. Lee barn should lift away smoothly if the technique is to be successful.

stalk (petiole) of about 74-76m (5-10mm) to act as a handle. It is best to use a specialized budding knife because it has a flattened part on the reverse of the blade or the handle designed specifically for lifting the bark on the rootstock.

Hold the budstick by the top end and select the first good bud. Insert the knife /=1in (2-2 5cm) below the bud. Make a shallow cut beneath the bud toward the top of the budstick, then lift the blade of the knife to remove the bud with a "tail" (see above). Keep buds clean and moist in a dish of water or wrapped in a damp cloth while you quickly prepare the rootstocks.

At a height of 6-12in (15-30cm) from the ground, make a T-shaped cut into the bark of the stock. The top cut needs to be only about #in (1cm) across, while

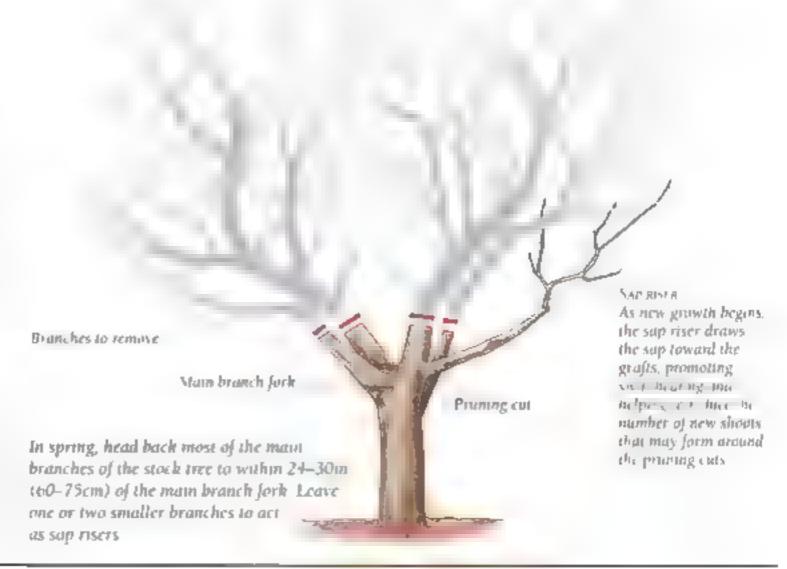


3 Hold the bud by its leaf stalk and carefully stide it in behind the flaps of bark on the stock. Term away any exposed "tail" so that it is level with the horizontal cut on the stock. Cut back the leaf stalk. Bind the entire bud with clear plastic grafting tape.

the vertical, downward cut should be 1-1 am (2.5-4cm) long. Press with the kmie firmly to cut through the bark, but take care not to score too deeply and cut into the pith. Using the spatula, lift the two bark flaps (see above)

Hold the bud by its leaf stalk and gently insert it into the T-cut on the stock, sliding it down between the bark and the pith beneath so that it is well below the horizonial cut. Do not push in the bud too hard, or it may be damaged. Sever the remaining tail of the bud by cutting into the bark again at the horizontal cut (see above). Then secure the bud in place with plastic tape or raffia in the same way as for a chipbudded ornamental tree (see box, p.61), leaving the bud uncovered to avoid exerting too much pressure on it.

#### PRUNING A FRUIT TREE FOR RIND GRAFTING



About six weeks after budding, the T-cut should have callused, so you can remove the tape or raffia. Thereafter, treat the budded plant in the same way as for a chip-budded tree (see pp.60–61)

#### INVERTED T-BUDDING

In some cases, such as in a wet chimate an inverted T-cut is made on the stock to prevent water from entering the graft and causing rot. This method is also frequently used for grafting cultivars of citrus (see Citrus, p 78). The technique is largely as for conventional T-budding, except that the bud is pushed upward beneath the bark flaps.

#### RIND GRAFTING

Sometimes it may be desirable to change a mature fruit tree (usually an apple or pear) from one cultivar to another, often to introduce a new pollinator for nearby trees and so improve cropping or simply to try a new cultivar. The newly grafted cultivar should bear fruit fairly quickly because it benefits from having a mature root and main branch system. This practice is known as grafting over and may be carried out by top-working a pruned-back tree

Rend grafting is often used for topworking and is usually the best way of inserting grafts into a large branch. It takes its name from the process of inserting scions under the bark (known as rind by commercial fruit growers). Ornamental trees are not rind-grafted it tends to create unsightly graft unions.

Rind grafting using dormant scions is carried out when the sap is rising in the stock tree so that the bark will lift easily, usually in midspring

To prepare a tree for rind grafting, you first need to cut back most of the main branches (see facing page and below). One or two branches are left intact to draw the sap toward the grafts, which speeds healing and callusing Take scions from pencil-thick ripened shoots of the previous season's growth

Graft one branch at a time cut the bark of the branch so that you can insert the scions. Make a long, straight cut through the bark down the branch as shown below. Make 2-4 evenly spaced cuts, depending on the branch circumference, then lift the bark

Prepare the scions as shown below then insert one scion into each cut in the bark. Make sure that the tapering side of the base of each scion lies inward so that it is in contact with the cambial layer of the stock branch. Bind them with grafting tape and seal the graft with grafting wax. The graft should unite and grow rapidly, so remove the tape after about six weeks to prevent constriction.

Only one scion will be needed to form the new branch but leave them all in place during the first growing season and remove all but the most vigorous one in the following winter if any shoots develop on the stem around and below the grafts, remove them when they are 3-4in (8-10cm) long

#### RIND GRAFTING A FRUIT TREE



I Head back all but one or two
for the main branches on the
rootstock, leaving a sap riser (see
facing page). From the back animal
the cuts, if her source, so that the
princed surface has no snage



2 With a clean, sharp grafting knife score a cut in the back that extends downward and of the 5cm) from the pruned and of the branch. Make up to four equally spaced cuts around the branch



3 With the reverse edge of the grafting kinfe, or with a thin spatiala. Lift the back to one side of each cut and carefully ease it away to expose the cambion cover of the branch beneath.



4 to prepare the scions, cut stems onto sections each with three nodes. Make a cut just above, and angled away from, the upper bud frim a 1 in (4cm) sliver of wood from the base, opposite a bud



5 Carefully shde a prepared some newath each cut in the bark on the stock. Make sure that the cut surface at the base of each soon is in close contact with the stock's cambian layer.



6 Bind the graft union with plastic grafting tape, making sure that each turn overlaps the previous one. Bind from the top of the branch to about 1 in (2.5 km) below the cuts and tie off the tape.



Franch with a wound paint or grafting wax to prevent entry of water Avoid coating the edge near the scions, so that the buds have room to swell and grow



In the following winter, remove all but the strongest scien from each branch, cutting flush with the pruned surface of the branch. The sciens will grow on to form the new branches (see above)

## LAYERING

This process may occur naturally in some trees, when one or more low-growing stems root into the ground this ability can be exploited in simple layering to obtain a small number of new plants. Air layering also induces adventitious roots to form on a stem, but it is carried out above ground and is useful for trees with an upright habit

#### SIMPLE LAYERING A TREE

Carry out layering from midautumn to early spring, ideally in mid- to late autumn for deciduous trees and in early

spring for evergreens.

Thoroughly cultivate the ground where the selected shoot will be layered Select a strong, healthy shoot, preferably of the previous season's growth, they are more pliable and most likely to root in the first season. Wound the shoot (see right) or twist it until the bark splits to concentrate the sap at the rooting point Peg down the shoot and stake the tip – tie it loosely to allow for new growth. Fill in around the shoot with soil mixed with rooting medium. Firm well to prevent natural settling of soil exposing

new roots, then water. Keep the layers watered during the summer Check for rooting in the following autumn: once rooted, layers of deciduous trees should be lifted in mid- to late autumn and those of evergreens in early spring

Cut each layer from the parent just below the new roots, then grow on in a nursery bed or pot singly. Trim back the parent shoot either to the main stem or an appropriate sideshoot. Most layers should be ready for planting out in 2-3 years, but some may take five years

#### AIR LAYERING A TREE

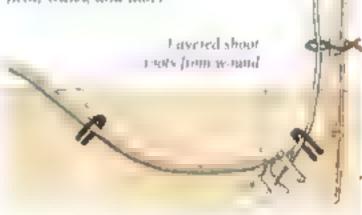
Air layer a shoot outdoors in early spring, or whenever the shoot is ripe, as shown below. Wound the stem by removing a ½—lin (1–2.5cm) wide ring of bark or cutting a tongue. Opaque plastic bags make the best sleeves because they retain moisture and reflect light, so the rooting medium does not become too hot. Once the layer has rooted and been potted, grow it on under mist or in a closed case as for rooted cuttings (see pp 50–52), and plant out two years later.

#### SIMPLE LAYERING A TREE



I Wound the shoot 12m (30cm) from the tip, on the underside of the stem apposite a bud. Cut off a 1-2m (2 S-Scm) sliver of bark, or cut a tongue and open with a matchstick

2 Dust the wound with hormone rooting powder Mix some rooting medium into the soil beneath and peg down the shoot each side of the want at a depth of 3-bin (8-15cm). The in the exposed shoot tip to a stake. Fill in firm, water, and label.



#### AIR LAYERING A TREE



I from the leaves (here of Fig. as clastica) from a straight length of stem. Make a sleeve by cutting the base of a plastic bog, slide it over the stem. Secure the lower end with tape



2 Make a slept grapward cut on some to he pand for 2 sens and sectional flist under the tongue with horozone totang pessaler then push in a little moist sphagmon news



3 Roll the sieeve into place around the wound Pack the sieeve events with more moss so it covers the wound completely Seal the upper end of the sieeve to the stem with tape



Wart until new 4 roots show through the sleeve or. if using an opaque sleeve, open it to check for roots after 2-3 months. (If the stem is slow to root leave it until the following spring) Remove the rooted laver, cutting through the stem at an angle just above a node on the parent plant with pruners. Remove the plastic sleeve



5 the moss from the roots Pot the layer into a pot about 2m (Sem) larger than the root ball. Fill with a potting mex suited to the plant. Firm gently to avoid damaging the roots. Cut back vigorous topgrowth to ensure the roots can sastain the new plant. Water, label, and treat as a rooted cutting.

## **PALMS**

Palms are evergreen and are grown outdoors in tropical and subtropical climates. They need moist, well-drained soil in full sun to deep shade, depending on the species. Some palms, such as Phoenix species and the palmettos (Sabal), come from sunny regions and can toierate sun as young plants, while palms native to rainforests, such as Chamaedorea, prefer shade even when mature. Many need shelter from strong winds. Cold winds can stunt or damage new leaves while hot winds increase moisture loss.

In warm climates, palms are grown outdoors, but elsewhere they must be cultivated under cover or as houseplants or outdoors in summer. A few tolerate some cold, however, such as Butia capitata and Trachycarpus fortunci. When propagating, the best way to mimic natural growing conditions for many palms is with a mist propagation unit (see p 44 and right) in a sunny greenhouse. This is a tent or case over a heated bench, which helps keep the soil mix moist and the air humid. It should be ventilated regularly to reduce the risk of rot attacking young plants.

Palms can be propagated in two ways, from seeds or by division. Most are best grown from seeds, which are relatively easy to obtain, but some palms produce suckers or offsets and can be more quickly increased by division

#### PALMS FROM SEEDS

Paims have inflorescences made of many small flowers, some flower repeatedly, while a few, such as Caryota rumphiana var. albertit, flower once and die. The fruits have moist flesh, as with the date

palm (Phoenix dactylifera), or dry flesh as in the coconut palm (Cocos nucifera)

Seeds are collected when the frons ripen and change color (see below). Clean off all the pulp to prevent rot then wrap the seeds in damp tissue paper or peat moss. To remove dry flesh, soak the fruits in warm water for 1-2 days until soft, then scrape off to reveal the seeds. The hard coated seeds are best sown fresh. Germinated seedlings can be held for several months in a container without fertilizer. When you want the plants to begin growing actively, transfer to another pot, water and fertilize, they will grow rapidly.

Purchased seeds may be supplied dry, if so, soak them in warm water for at least 24 hours and up to two weeks, then sow at once. File (see p.53) or crack them carefully in a vise or nutcracker to enable moisture to reach the seeds for germination

#### GATHLRING PALM SEEDS



I is soon as the berries there of Coccothrinax tragrams) ripen and change color usually from green to red or puople, cut off a hunch

#### MIST PROPAGATION TENT



A mist propagation tent in a greenhouse allows in plenty of diffuse light. Heating cables provide bottom heat of 77–82°F (25–28°C), and humidity is kept close to 100 percent with fine water sprays from overhead papes.



2 Peel off the flesh and sow at once Seeds may be stored briefly at damp tissue paper near plantic ong at 68 ( )

#### A-Z OF PALMS

BURASSUS Seeds as for large taprooted seeds (see p 66), germination 2-4 months 111 Be TIA Sow seeds in spring; life or crack woody coats 11. Seeds of Jelly palm (B capitata, syn-Cocos capitata) are difficult to germinate (in 6-8 weeks), soak m warm water for up to 48 hours !!! Slow-growing CARTOTA FISHTAIL PALM SOW fresh seeds spring to summer 1. Germination in 3-6 weeks. trancle toxic seeds with care Divide suckering species such as C. mitis in spring 🚻 CHAMAEDOREA Seeds in spring germination in 6-8 weeks 1. COCOS NOCIFERA COCONUT. SOW seeds in spring as for large

seeds (see p 66) at B1-86°I (27-30°C) gerentation in 5-6 months: growth is rapid 1. DYPSIS (syn. Neodypsis) Divide basal offsets III HOWER SENTIN DRIM SOW seeds. spring to summer [1]. Slow and erratic germination in 1-2 years or more. Grow seedlings in well-drained rich soil in bright indirect light and mild humid conditions, lightly fertilize in the growing season JUBARA CHILRAN WINE PALM, SOW seeds in spring, germination in 3-6 months 1. LATANIA LATAN PALM. Sow seeds in spring 1. LAUNTONA FAN PALM. Sow seeds in spring at 73°F (23°C) 1

Cermination in two months Grows best in senushade with deep femile soil. Only feeting of cabbage palm (L. dustralis) needed to set seeds, which tolerate some drying out but then take longer to germinate LODOR DA COCO-DE MER DOUBLE COCONUT. Sow seeds as for large seeds (see p 66) 11 Has 311 (1m) taprou-PHOENIX Sow seeds spring to summer germination in 1-2 months 1. Protect from direct sun for 2-3 years. Divide suckers, slow-rooting offsets need humidity at 86°F (30°C) until roots form, seedlings need 64-68°F (18-20°C) [] RHAPIS LADY PALM. Sow seeds in

summer germination in 4-6 weeks 🚻 Divide basal ellseis [d ROTSTONIA ROMAL PALM. SOW seeds in spring, germination in 2-3 months [1] SABAL PALMETTO, Sow seeds in spring, germination two months Division of basal offsets 🕌 Tolerates wide range of soils TRACHYCARPUS Sow kidney shaped seeds in spring 1. Fire or nick woody seed coats to pilow moisiure to penetrate and begin germination, in up to two months Needs sun WASHINGTONIA Sow seeds spring to summer germination in 4-6 weeks 1. Protect from strong sunlight until one year old

#### SOWING PALM SEEDS



eventy and not too close to the rim term they may dry dat. Cover with their own depth of soil mix

#### SOWING PALM SEEDS

Palm seeds are best sown in pots. Deep clay pots are preferable; they prevent waterlogging and accomodate their long taproots. Fill each pot with a suitable seed soil mix, such as equal parts of peat and fine grst, water it well, then allow to drain. Sow the seeds evenly (see above) An air temperature of 86-97°F (30-35°C) and high humidity are essential for a good rate of germination Never allow the seeds to dry out otherwise, they will die Germination can take from three weeks to 18 months Don't expect more than two-thirds of the seeds to germinate

Seeds sown in warm climates usually germinate up to a week earlier than in colder climates. Protect pots of seeds from harsh sunlight by placing them in a shade house (see p 45) with 30-45 percent shade, depending on the region

In colder climates, place a heated closed case supplying bottom heat of 77-82°F (25-28°C) in a sunny spot in the greenhouse to provide maximum heat and light. Maintain the humidity by watering regularly and lightly spraying over the pots. Alternatively, use a mist propagation unit (see pp 44 and 65) Overheating can cause the seeds to rot, so ventilate the unit regularly

For large quantities of palms, sow seeds in drills in a raised seed bed (see p 55) in motst, light, free-draining soil or soil mix to minimize damage to the roots when transplanting seedlings

#### PREGERMINATING PALM SEEDS

If space is limited, palm seeds may be pregerminated in a bag (see above right). of soilless mix or damp peat moss, kept under a greenhouse bench or in a warm cupboard. Seeds treated in this way germinate earlier - usually in four to eight weeks, depending on the species. The seeds should be checked

Lyal germinat in a is 50-70 percent

Keep the pot in a warm, bright humad position. Once their first. leaves have formed, usually about two months after sowing, pot the

> seedings. The mots of each seeding should be well developed (see inset)

Pot each seedling Individually into a pot that is just larger than its root system Label water, and grow on in Juonid shady conditions Boost the young plant with a John fertilizer while it is in active growth



PREGERMINATING PALM SEEDS

1 Mix the seeds (here of Caryota I mites) with moist peat in a clear plastic bag. Scal and label the bag. then keep it in light shade at about 66 F (19 C When the roots are about 2in (5cm) long (see inset), pot the seedlings

daily for signs of sprouting, then potted before they become too large. Seeds produce roots first, then shoots, but they can be potted as soon as they have roots

To reduce the risk of rot, pot the seedlings into pots just larger than their roots. A potting mix of equal parts coarse bark, soil, fine grit, and peat, or one of equal parts loose rockwool, soilbased mux and perlite, with a little slowrelease fertilizer, is suitable. Keep the seedlings in humid, bright shade for four to six weeks after potting until they are established

#### LARGE PALM SEEDS

A few palms have giant seeds that send out long taproots, or "sinkers," such as the double coconut (Lodorcea maldivica) or the toddy palm (Borassus flabellifer) These are best direct sown individually in a deep container (see right). A large seed may be sown in an outdoor bed, but the conditions may not be ideal for



Handle each seedling by the sirel line t 🚣 avoid damaging the new roots and any shoot Pot singly in 2-3in (5-8cm) pois of a suitable potting mix-covering each seed to its own depth. Water and label the pots. Grow the seedlings on in humid, bright shade

#### LARGE PALM SEEDS



For coconuts and other paons that produce large seeds, choose a deep pot to allow the taproot to develop. Half bury each seed in a suitable. potting mix. After germination, grow on the seedling in the same container, the seed thisk will gradually disintegrate as the shoot develops

germination, and the sinker will be open to attack from insects and other creatures. The seed should be only half buried, leaving the top exposed so the seedling can emerge directly into light

#### CARE OF SEEDLINGS

Seeding palms need protection from hot sun for two to three years, rainforest palms are particularly vulnerable to harsh light. They tolerate much more sun if they are well watered than those allowed to dry out between waterings. Moving any palm seedling from shade into very bright sun can severely scorch the leaves. If planting positions are in full sun, keep the seedlings first in filtered sunlight, and keep well watered.

Summer watering is essential, water frequently and thoroughly, and mulch the seedbeds. A light foliar feed may be applied during the growing season

#### DIVIDING PALMS

Some palms, such as Chrysalidocarpus species, lady palms (Rhapis), Phoenix and some Chamaedorea, readily produce offsets, or suckers, at the base of the plant. These may be removed, usually in spring, and then potted or planted out, depending on the climate (see below). Division is a fairly simple technique, but care will be needed to prevent rot from entering the wounded tissue, in which case the division will fail

If the base of the offset is below soil level, carefully scrape away the soil with a hand fork or remove the plant from its pot to expose the roots. Cut off the offset, retaining as many of the roots as possible to enable the offset to establish Gently ease it free, avoiding any damage to the parent plant, which will leave it vulnerable to rot. If needed, dust any

wounds to the parent's roots with a fungicide before replacing the soil or reporting. Trim the offset's roots, treat with fungicide, then plant out or pot

A good potting mix can be made from equal parts peat, fine bark, fine grit, soil, and coarse sand. Pot the offset in a clay pot just large enough for the roots. The young plant must be shaded from hot sun at a minimum air temperature of 66°F (19°C) and kept well watered until established

If planting an offset outdoors (see below), choose a shady site with moist soil, sheltered from the wind if possible Make sure that the planting hole allows the roots to spread out naturally

#### ROOTLESS OFFSETS

Some palms have very few roots, so extra care is necessary with these. A rootiess offset is still obtaining nutrients from the parent plant. Root growth can be stimulated by cutting a notch, or slice, at the base of the offset. Dust the wound with fungicide, re-cover it with soil, and keep the offset well watered Remove any leaves to enable the offset to conserve moisture.

Alternatively, remove the rootless offset and seal it in a clean plastic bag Leave it in deep shade at a minimum temperature of 66°F (19°C), in a greenhouse if necessary. In this case, there is no need to remove any leaves, because the sealed bag preserves a humid atmosphere. Ventilate the bag by opening it for an hour or two each day

After a few months, roots should form open the bag to harden off the offset for a few days, then pot or plant out. Plant the offset slightly deeper than before to encourage root growth, and remove some of its leaves to reduce water loss. Keep the offset well watered, and do not allow it to dry out.

#### DIVIDING AND POTTING A PALM OFFSET



1 Fase the palm there a lady palm) from its pot Select an offset with 3-6 pairs of leaves and a good root system. Gouly tease out the offsets roots wan a hand fork.



2 the primers to sever the offset from the main stem cutting straight across the toot as close to the parent plant as possible. Return the parent plant to its pot



3 the offset should have a vigorous, healthy toot system that is in proportion to the represent. Term off any damages of diseased roots with a clean, sharp kinfe



A Protect the cut root of the offset from rot by dipping it in a small quantity of fungicidal paivider, such as solur dust. Shake off any excess powder if it is too thick, it may hinder rooting



5 Place the offset in a pot past large enough for the roots, then backfill with a statable soil our keeping the offset at the same depth as it was before (row no warm shade with high humadity

#### PLANTING AN OFFSET INTO A BED



Io devide a polm growing in open ground, first select an offset from the parent plant chere a lady paim). Detach and prepare the offset (see steps 1 to 4 left), taking care to avoid damaging the mothait Restore the soil around the parent's rootball.

Prepare a planting hole in open, well-drained, moist soil. Make the hole sufficiently large to spread out the roots of the offset naturally. Locate the soil mark on the stem and plant at the same depth. Firm in gently, water in, and label.

# **CYCADS**

Cycads resemble palms, being evergreen trees or shrubs, but are botanically unrelated. They are primitive plants, reproducing by means of seeds produced by unisexual conclude structures, which bear either ovules or pollen sacs. The ovules develop into seeds. Some cycads produce suckers, or offsets, which can be detached and grown on Propagation is very similar to palms (see pp 65–67), therefore, but it is more challenging.

#### CYCADS FROM SEEDS

When raising cycads from seeds, the gardener can expect a success rate of no more than 50 percent. To achieve the best possible rate of germination, the seeds should be tested for viability and then prepared before sowing

SOWING PREGERMINATED SEEDS

A mature male and female cycad are needed to produce viable seeds. Gather the seeds when the "cones" fall to the ground. The nuthke seeds are up to 3m (8cm) long, with a woody casing covered by a thin red, yellow, or orange pulp. This fleshy outer coat contains an inhibitor that delays germination and so must be removed: peel or scrape off the flesh, then wash the seeds in water

Many cycad seeds may be infertile or dead, so it is worth sorting them before sowing. A quick way to test viability is to shake them: any that rattle are not viable. Another method is the flotation test. Drop the seeds into water. If they float, they are not ripe, if they sink, they should germinate. This test is not totally accurate, seeds of some Cycas species float to be dispersed by the sea.

To allow moisture to penetrate the

seed and mitiate germination, make a shallow cut in the hard seed coat at one end of each seed, using a sharp knife or file (see below). Take care not to cut too deep, which will damage the embryo.

in warm climates.
If the seeds are more
than two weeks old

longrowth emerges oils when tapion is well decouped they should then be soaked in warm water for up to 24 hours to improve the rate of germination. In cool climates, soak the seeds for two or three days

#### SOWING CYCAD SEEDS

A good seed soil mix for cycads can be made from equal parts compost or peat, and three parts coarse grit. This mix provides good aeration and moisture retention. Cycad seedlings have long taproots, so it is best to sow them singly in deep clay pots. Sowing in a raised seedbed is not recommended because the roots are very sensitive and root disturbance will either kill the plants or check their growth.

For best results, the seeds may be germinated before sowing (see below left), but seeds may also be sown direct into pots (see below). The seeds should be half exposed and should be kept well watered and misted

To germinate, cycad seeds require a minimum air temperature of 70–86°F (21–30°C) and 60–70 percent relative humidity. In cold regions, these conditions can be provided in a heated closed case or a mist propagation unit (see pp 44 and 65). Cycad seeds usually take much longer – from four to 15 months – to germinate than those of palms. Fresh seeds take a week or two less to germinate in warm chimates.

SOWING SEEDS IN POTS

### than two weeks old warm chmates

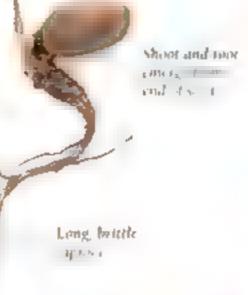
1 Had fill a cicar piastic bag with

I moist peat. Put in a dozen seeds there of
Macrozamia moorer, see insert, seal and label

Nacrozamia moorer see inserr seat and a keep or light shade with bottom heat of 77–82°F (25–28°C) until seeds germinate



When the roots emerge, sow the seeds in a suitable seed soit mix in deep pots, which will allow the taproot to develop. Make suit that the root is covered, but leave the seed case half exposed. Water well and label



3 Grow on the seeding in high humidity in light shade Provide bottom heat to create a near man at temperature of 66% (19%) Keep well watered until the shoot emerges, and pot when it has two or three leaves



Ain (1-2mm) (see inset) to avoid damaging the embryo Soak for 1-2 days. Prepare deep clay pots with a suitable seed soil mix and press each seed horizontally into the surface to half its depth. Water and label, then grow on in warm shade with high himidity.

#### CARE OF CYCAD SEEDLINGS

Once the taproot is well established and the shoot has two or three leaves, pot each seedling. Take care, because the young root is very brittle. Use a potting mix of equal parts of coarse bark, coarse grit, shredded rockwool or medium-grade perlite, soil, and peat - or of equal parts soil-based potting mix, rockwool, and perlite. Add a little slow-release fertilizer

Place the seedlings in a shade house (see p.45) or greenhouse with 40 percent shade and high humidity. Keep them well watered. A twice-monthly application of half-strength liquid fertilizer during the growing season is beneficial

Some eyeads tolerate hot sun from an early stage, but others, such as those that originate from rainforests (for example, some Zamia species) need gentler treatment. The seedling leaves are very sensitive, and hot, bright sunwill scorch them. Most new plants need a period of hardening off. Keep them in shade for at least three to four months, and gradually bring them into full sun over a period of one year

Sun-hardened cycads are generally quite tolerant of wind, but rainforest species may suffer. Cold winds may damage new growth, while hot winds may desicate leaves. Plant out seedlings when they have developed good roots and a few leaves, this is generally after 2-5 years, depending on the species

#### DIVIDING CYCADS

Cycads may be propagated from the offsets, or suckers, that are produced on the trunk or at the base of some plants The offsets must be removed and handled with care until well established

To detach a basal offset (see right), remove the soil or soil mix to expose the base where it is attached to the parent plant, and cut it off. Trim the wounds and treat with fungicide to stop rot from entering the damaged tissues. If the offset has much topgrowth, remove the lower leaves to reduce moisture loss and treat the entire offset with fungicide

Hang the offset in a cool, dry place until the wounds heal. Prepare a large clay pot with a soil mix made of equal parts peat and coarse sand or grit, or of



CYCAS REVOLUTA WITH OFFSETS

layer of soil mix with a trowel Slice off an offset from the base of the trunk with a clean, sharp knife or with a pruning saw



To prevent the trunk of the Le parent plant from rotting from the wound, if its cossacy, to have a smooth surface and diest the cut with finguide such as salfur dose



Trim the wound on the offset to produce a Itan surface free of any snags. Dust the wound with fungicide (see Inset) to protect it from rot. Take care not to touch the wound with your hands to avoid contamina ing it

equal parts soil-based potting mix perlite, and rockwool. Pot the offset and, if necessary, stake it to protect the fronds

Divided offsets need very similar conditions to seedlings (see above) to establish successfully, generally this will take 1-3 years, depending on the species. In colder climates, root growth is greatly improved in a mist propagation unit (see pp.44 and 65).

Some cycads, particularly Cycas, may produce offsets from their trunks when



4 Place the offset in an open T meshed bag that atlows free are circulation, bring in shody tor 1-3 days to allow the a mile off is out

🚝 Pot m a 6-8m c13 2dom pot at the same depth as it was before and support with a stable Grow on in light shade at a mason ide of 70°F (21°C)

mature Although much smaller than basal offsets, they still yield vigorous plants. The offsets begin as small swellings on the trunk, often caused by damage, which then produce leaves. Once the growth is developed, detach it as for basal offsets (see above).

#### A-Z OF CYCADS

BOWENIA Sow fresh seeds, germination takes up to one year 11. CYCAS FERN PALM, SAGO PALM, SOW seeds at 43-54°F (6-12°C) | Seeds of Zamia palm (C. mcdia) germinate in 6-8 months 1. Seeds of Japanese sago palm (C revoluto) germinate in 3-4 months 11. Division of

basal offsets, 6-8 months to rooting \$\$\$\$ Dioos. Sow short-lived seeds fresh germination in 6-18 months, seculings are fast growing !!

ENCEPHALARTOS Sow seeds in spring. germulation in 2-6 months, seedlings grow fast in favorable conditions 1.

LEPIDOZAMA Sow short-lived, toxic seeds fresh after removing outer seed coat, up to two years to germinate, then last-growing 14. MACADZAMIA Sow seeds in spring \$\$\$ M moorer germinates at 50-59°F (10-15°C) ZAMIA Sow seeds in spring, germination in 2-4 months L

# CONIFERS

Most conifers, whether trees or shrubs the principal methods being cuttings seeds, and grafting. Taking cuttings is the easiest method for many types, suitable for selected cultivars and clones, and yields a number of identical plants—ideal for an avenue or hedge. Species are most often raised from seeds (cultivars may not come true) but this may be slow. Grafting is usually used if seeds are unavailable or for cultivars that do not root well from cuttings.

#### TAKING CUTTINGS

Conifers are usually propagated from the current year's growth, using semi-ripe or ripewood (fully ripe or woody) cuttings. The basic principles are similar to those for other trees and shrubs, but there are some key differences. The main one is that many conifers make new growth from specialized buds, the way a shoot develops is determined by where it is located on the parent plant. In coniferous trees, leading or main shoots grow more or less straight upward, while sideshoots grow outward. With most conifers, it is very difficult to make a

TAKING CONIFER CUTTINGS

e often fre to pe

and the back

cutting taken from a sideshoot form a leading shoot (although with pines and deciduous types, there is no problem) with some, such as monkey puzzles (Araucaria), it is almost impossible

Even with cypresses, which generally form leading shoots quite readily, there are several cultivariants. These are forms created by taking cuttings from different parts of the same parent, each part has different genes "switched on," so that the various cuttings produce cultivars that are genetically the same but different in their form or growth pattern (such as a naturally dwarf form). The differences in form remain fixed in the cuttings, as in cultivars of Lawsons cypress, for example Chamaccyparis lawsoniana [ llwoodn' and Fletchert ).

Cuttings taken from young (juvenile) growth usually root best. Such growth persists into the mature plant with the cypress family, including Cupressus Chamaccyparis, and junipers. In spruces (such as Picca), however, the juvenile factor fades (often after only five or six years), and cuttings from older trees are less likely to root. It is also essential to take cuttings from growth that is yigorous, not weak or sickly (see right)

#### TAKING CUTTINGS MATERIAL



Select strong leading shorts with young foliage at the tips (these have the best growing points) lake 2-6m (5-15cm) long cuttings of the semiope or tipe wood cutting first below a node

#### WHEN TO TAKE CUTTINGS

Take cuttings from summer until just before growth resumes in spring, ideally in early to inclautumn or in midwinter peak times for rooting ability. Easily rooting conifers root well throughout this period, but the more difficult ones tend to root poorly, except during one or



2 If needed, strip off the sideshoots or needles from the bottom third of each stem there of Chamaecyparis 'Chilworth Silver The small wounds left on the stems encourage rooting



3 Dip the base of each cutting in hormone rooting compound chere powder) Insert easily rooted cuttings singly in 3m (8cm) pots make a hole, insert a cutting, firm, and water



7 Prepare a pot, adding a pinch of slow-release

I fertilizer at the bottom (to avoid burning the new roots). Take young shoots, not adult ones

with fruits (see inset, left

4 Insert 6-7 cuttings of slow-rooting conders there Jumperus conferta) to a 6m (15cm) pot, in case some do not take Label all cuttings



chi e cui ngy raot increase venalanan

5 Spray the cuttings with a fungicide to prevent rot Place them in a heated closed case or in a cold frame. Check weekly and water lightly if needed but do not sourate the median Shade the cuttings from hot san to avoid scorch. They should root in three months.

other (or both) peak times. (See A-Z of Garden Trees, pp 74-91 for details of specific plants.) Different clones of the same species often show markedly differing rooting ability. If you take cuttings in early spring, they are starting to make new growth, even if it is not apparent, so they are unlikely to have sufficient reserves to make roots as well in late spring and early summer, the growth is too soft and will rot

#### PREPARING CONIFER CUTTINGS

The rooting medium should be well-aerated (oxygen around the bases of the cuttings aids rooting and helps to prevent rot) and able to retain moisture. You could use peat, perlite, conifer bark, or vermiculite, or mixtures of these with coarse sand, in equal parts (see pp 33-4). If the cuttings are to be under mist, use a higher proportion (3-1) of sand, perlite, or vermiculite. Do not firm the medium in the pots.

Cuttings are usually prepared as shown (see facing page), from one-year-old growth. This tends to determine the size of the cutting, but it should be no longer than 6in (15cm). With scale-leaved conifers such as cypresses, remove sideshoots from the base of the cuttings. Retain the need-clike leaves of cuttings from conifers such as spruces—they may aid aeration at the base.

#### CARING FOR THE CUTTINGS

Root cuttings under plastic film on a heated bench (see p.44), under mist, or m a sheltered site such as a heated cold frame (cuttings in the open outdoors will not tolerate freezing temperatures) If using a heated bench or mist, take the cuttings in autumn or late winter Late winter is best if using bottom heat (see p.41), which should be at about 68°F (20°C), because less heat is needed Make sure that the bottom heat does not dry out the bases of the cuttings, this is less of a problem with mist (1 using a cold frame, take cuttings in autumn and shade them from direct sun while letting in as much light as possible Rooting with heat speeds the process by a few weeks

Although there will be little or no sign of any rooting activity in cuttings taken in autumn, they will form root initials over the winter and will probably root only as new growth is made in the following early summer

Once the cuttings are well rooted, pot in a soil-based potting mix (see p.34), with slow-release fertilizer to encourage vigorous growth. Provide partial shade for a few days until they settle in their roots, then place in bright aght to stimulate growth. Control vine weevils with an insecticidal or nematode drench in midsummer and autumn

#### SELECTING RIPE CONES



Many cones change color as they ripen, usually in the late summer or autumn. Pinus sylvestris, the Scots pine (see above), turns from green to brown. When guthering cones for seeds, take them just after they change color, but before they start to open (debisce)

#### CONIFERS FROM SEEDS

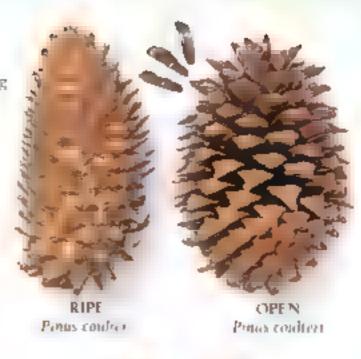
Raising conifers from seeds is the most economical way to raise a large number of plants, but some species are slow to germinate or grow. Conifers produce seeds in cones (modified from leaves), hence their common name. Nearly all conifers are gymnosperms, which means "naked seeds"; unlike other plants, the seeds are not enclosed in a fruit or a capsule and develop while exposed to the air (see also p.16). Comfer seeds may be sown in the same way as other tree seeds (see pp.53–55), but they are unique in the way they are collected.

#### GATHERING THE CONES

Conser fruits usually ripen (see above) in autumn, changing color in the process. They may ripen after one, two, or three summers, depending on the species, it is important to know which, because immature cones may look very similar to ripe ones, but unripe seeds will not germinate. This is particularly important for genera such as Juniperus, where in some species the only visible difference is a change in the fruits from green to blackish purple or blue, or in Cupressus, where one-year-old cones look mature. (See A–Z of Garden Trees, pp 74–91 for details of specific plants.)

The first necessity is to find a tree that is fruiting well. Confers are wind-pollinated, and little pollen is carried more than 300ft (90m) or so. Although confers can self-pollinate, the number of seeds fertilized, or set, is usually quite low unless there are several plants to ensure adequate cross-pollination. Also, if there are few cones, it is likely that conditions were unfavorable for pollen production, so expect few viable seeds

Gathering cones from tail confers may be difficult, but wind and animals often detach cones, and usually some may be found on the ground. Avoid any







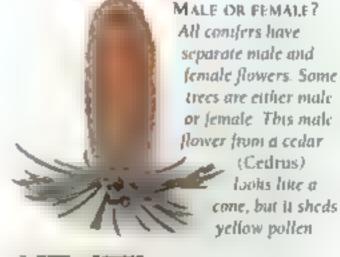
OPFN Isuga horeaso

with signs of insect damage, indicating that a cone-eating insect has beaten you to it. Take care to collect only female, seed-bearing cones (see box, below)

If necessary, it is worth gathering cones that are nearly ripe, because the seeds are often viable (albeit at a lower percentage) a couple of months before the cones ripen fully. Some confers retain seeds in the cones for a long time. These are mainly certain pines (Pinus) whose cones open in the wild only after a forest fire (which removes competing vegetation and leaves a natural seedbed). A few viable seeds may persist in the old cones of most (continued on p.72)

#### AVOIDING PITFALLS

When collecting seeds, take care to select only the female cones, which contain the seeds. Beware of galls or male cones that may look similar to female cones



cone, but it sheds
yellow pollen

PINEAPPLE GALL
Certain spruces
(Picea) near develop
conellike galls,
caused by aphidbhe
adelgids. A gail
there at the base of a
shoot) is identified

by needles sticking

out of them.



#### EXTRACTING THE SEEDS



Put just ripe cones in a paper oned cardboard box and tabel feave the box in a warm closet or over a radiator and the scales open



2 When the cones for fully open, tip out the winged seeds. Use tweeters to pull out any seeds that are lodged between the scales. With these confer cones, the dark seeds are more likely to be viable than the pule or is



3 If a color a flavence is not apparent, cut some seeds in half (see insets) to gauge which proportion is viable. Nonviable seeds will be fat

#### CEDAR CONES

Female cones of the cedar (Cedrus) take three or four years to ripen (see right). The young cone may only be 1in (2.5cm) long by the first autumn. In the second year, although the cone is much higger, it is green and still anripe. By the third autumn. the cone begins ripening and changing color but remains unopened. This long process can he accelerated by picking brown closed comes and alternately soaking and drying them to prompt dehiscence. Soak in tepid water for 12 hours, then dry in gentte heat for 24 hours



members of the Pinaceae, except for the firs (Abies)

After handling cones or seeds, your fingers will be covered in resin, which is hard to remove with soap or commercial cleaners. The simplest solution is to rub a little butter into the resin, then use soap or detergent to remove the butter

#### EXTRACT NG THE SEEDS

Extraction is usually a matter of letting the cones open to release the seeds. With a few exceptions, they have no fleshy coat or hard covering to be removed. Any surface moisture should be dried off (at which stage they can be stored), but do not try to force open the cones. Instead, lay them out on a tray or in an open box and let them dry naturally at room temperature at first, especially if they are still slightly green. Once they are fully ripe and dry, the scales should part naturally and start to release the seeds.

If they fail to open, provide some neat, up to 104-113°F (40-45°C), one

way is to place them in a cooling oven Most seeds will fall out (see above), but some will remain lodged in the cones Pick them out with tweezers, shake the cones vigorously in a large plastic bag, or tap the cone tip on a hard surface

Many conifer seeds, for example the noble fir (Abres procera), have a wing to aid dispersal, you may remove or retain it without affecting germination. In some genera, especially firs, cedars, and bald expresses (Taxodium), the cones break apart on maturity, then the seeds and scales fall off (see box, above). With these conifers, soak the cones for several days before drying them. Once dry, separate the seeds from the scales.

In a few of the soft pines, the cones fall intact and do not open, break them open manually – this may be difficult. The seeds of jumpers, yews (Jaxus), and some other conifers have a fleshy coat. It is not essential to clean this off because it should break down naturally, but removing it may hasten germination

#### STORING CONIFER SEEDS

The seeds of nearly all confiers may be stored for five to 20 years or more in a refrigerator at 34-39°F (1-4°C), or for even longer in a freezer at 8°F (-18°C). First dry the seeds in a warm, any place before putting them into clean, labeled plastic bags or small containers.

#### TESTING SEEDS FOR VIABILITY

A high proportion of coniler seeds are usually dead or infertile. There are two methods of testing the seeds before sowing Place large seeds such as those of pines (Pinus) in water. Viable seeds will sink, while any insect-infested and empty seeds will float. This will not work with seeds of some conifers, such as firs, however.

The alternative test involves cutting a sample of the seeds in half (see above). Nonviable seeds are hollow or have only a little resin, viable seeds have a lat, usually white, embryo

#### BREAKING SEED DORMANCY

Some conifer seeds are dormant and need to be treated before sowing (see p 54), while others germinate easi videously if stratified for a short period in a refrigerator. Mix the seeds with moist peat or sand and chill at 34–39°F (1–4°C) for about three weeks, then sow immediately (if the seeds germinate in the refrigerator, sow them at once)

Some seeds are doubly dormant and do not germinate for several years, such as jumper seeds. Speed the process by mixing them with damp peat or sand and giving them a warm period of about 20 weeks at 59–68°F (15–20°C), for instance in a heated closet, then a cold period of 12 weeks in the bottom of a refrigerator. You may prefer to wait, it takes less effort and is more reliable

# GRAFTING

As for other plants, grafting conifers involves uniting a scion of the plant you wish to propagate onto a rootstock it is used where seeds are not available (as with cultivars) or are inappropriate and with conifers that are difficult to root or grow poorly from cuttings, such as blue spruces (Picea pungens)

With conifers, the rootstock acts mainly to provide roots rather than to control the growth of the crown (such as with fruit trees, see p 56), so it is destrable for the seion to root as well

There are two principal seasons for grafting, late winter, which is suitable for all conifers, and late summer, in which mainly blue spruces are grafted

SELECTING ROOTSTOCKS AND SCIONS

The rootstock is usually a two-year-old plant and should be a species that is compatible with the scion, ideally, use one as closely related as possible. Grafts involving different genera are possible – larch (Larix) and Pseudotsuga can be grafted onto each other – if necessary. In addition, the stock must have a similar

growth rate to the scion, otherwise, there will be an imbalance at the union and graft incompatibility may result. Graft incompatibility may occur at any stage

For best results, pot the stocks some months before grafting so that they are well rooted (but not potbound). With plants grafted in late winter, bring the stocks under cover in midwinter, then prompt them to make root growth by keeping them at 50–59°F (10–15°C). It is also possible to use bare-root stocks for winter grafts.

The selection of scion material is very important, because of the tendency of sideshoots to grow only sideways (see "Taking cuttings," p.70). Take healthy leading shoots of the previous or the current year's growth, 3–6in (8–15cm) long, preferably from the outer, upper crown. Weaker shoots of cypresses and pines will also grow well.

For winter grafting, collect scions from fully dormant conifers in early to midwinter. Store in plastic bags in the refrigerator at or below 39°F (4°C). For summer grafting, collect scions in the morning and keep them in plastic bags in cool shade to avoid moisture loss.

#### GRAFTING A CONIFER

The technique used is the spliced sideveneer graft, as shown below. For each graft, a rootstock and scion of similar diameter is best. Trim off any sideshoots and pinch off any needles from the base of the stock but do not cut it back, this is essential to draw the sap upward and promote healing of the graft.

Working as near the base as possible, cut a piece of wood from the stock (see below) so it can receive the scion. Strip the leaves from the lower stem of the scion. Make matching cuts to shape the scion so it fits the cut on the stock. Do not cut into the scion to the pith — this will hinder its ability to callus over

For a successful graft, it is imperative that the cambiums (the thin layer of regenerative cells, usually green, just beneath the bark) of both stock and scion meet. If the stock cut is broader than that on the scion, align the cambiums on one side only. Be careful, since there could be a difference in bark thickness. The best union will often form at the pointed end of the scion tand if scion rooting occurs, the roots usually come from the base of the scion on one or both sides)

Bind the graft as shown, but do not apply too much tension. The purpose is to hold the cambiums together so that the graft union can develop, the scion just above the top of the cut and the shoulder at the base of the cut are both susceptible to being crushed

# SPLICED SIDE-VENLER GRAFTING



I Scar the poststocks have the P mus sylvestris) cat downward obliquely, a quarter of the way into the stem



2 Make a 1-on (3cm) long flat cut down the stem to noish at the first cut Remove the sliver of wood (see inset)



3 Strip off the leaves from the bottom 2m (Sem) of the scion. Cut it to make the stock. Do not not once the pate.



4 Align the prepared scion tisee inset) so that it fits snugly into the cut on the stock. It is important that the campiums meet exactly



5 Bind the stock and scron family, but not too tightly with grafting tape or a in (1cm) wide rubber band. Bind the entire cut (see inset)



6 Plunge in a poi of moist peat to cover the graft Label, put in a plastic film tent or covered bench until a callus (inset) forms

#### CARING FOR GRAFTED CONIFERS

The grafts must be kept moist and warm plunge pot-grown stocks in moist peat or lay bare-root stocks in a tray of moist peat, leave the foliage free. Place the plants in a plastic-film tent or covered case in full light, but not in direct sun. Bottom heat of 64–68° i (18-20°C) or a hot pipe (see p.109) in late winter will hasten union of the graft but is not necessary in summer.

After 5-6 weeks, the graft should start to unite and form a callus. Admit air gradually over the next month or so to harden off the plants. After about three months, they may be taken out of the humid environment. If bare-root, the grafted plants may be potted or lined out in a nursery bed to grow on

Start removing the topgrowth of the stock in one or two stages once the scion has made 1/10 (1-25cm) of new growth. With Abies and related conifers, head back the stock slowly, pinching out new shoots rather than cutting back the stock, until the scion has grown actively for about a year. The stock's foliage is essential both to feed the roots and to draw sap from the roots to the graft. Removing it too quickly risks starving both roots and graft.

# A-Z OF GARDEN TREES

# ABIES FIR



Winter 111
SEEDS in spring 11
GRAFTING in mid- to late
winter or late summer 111

CUTTINGS in mid- to late

Abres By contra

Female cones of these conifers are usually erect, male cones are pendent. Hardwood

cuttings root only if taken from younger trees. Seeds are reliable but slow. Rare plants are best grafted

#### C. IT NOS

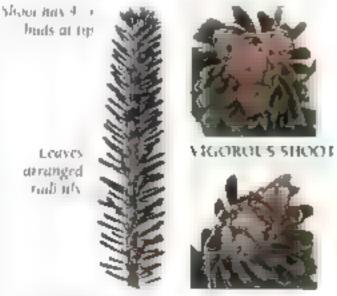
Treat hardwood cuttings (see p.50) from ripened current seasons growth with hormone rooting compound. Root in a plastic-film tent with bottom heat of 59–68°F (15–20°C). Rooting is usually slow. After bud break in spring, feed the cuttings to encourage strong growth.

#### SEEDS

Ripe cones break up, as for cedars (see p.72) Soak in water for 30 hours, then cold stratify the seeds for 4–6 weeks before sowing (see p.54). The seedlings should appear after 3–4 weeks, they do best at 50–59°F (10–15°C). Transplant them in the second year

#### GRAFTING

For rootstocks, use any Abies of similar thickness to the scions: the best are A. alba, A. nordmanntana, and A. grandis. Use a spliced side-veneer graft (see p 73), and set the base of the scion below soil mix level to encourage rooting from both sides. Place in a plastic-film tent at 64–68°F (18–20°C) to callus. Head back the rootstock gradually over two years, otherwise, the scion and roots may die



SUITABLE SHOOT WEAK SHOOT SELECTING SCION MATERIAL

To ensure a grafted plant (here Abies koreana) has a treelike habit, take scions from shoots, with leaves arranged radially, that grow directly from the trunk (epicormic). Alternatively, take strong shoots with a whorl of 4–5 buds (see top inset) from the outer upper crown.

# ACACIA MIMOSA, WATTLE



GREENWOOD CUTTINGS IN early to midsummer [1]. ROOT CUTTINGS in early to midwanter [1]. SEEDS in early spring [

hanta hantevana

Most of the many fastgrowing trees in this genus are rather tender Seeds are the only

natural, and most effective, means of increase. Cuttings give limited results Young Acacia resent root disturbance so raise seeds and cuttings in individual containers and plant out after 1–2 years for flowers in the third year

Take greenwood cuttings (see p 52) with a heel, rather than a wound, and insert into cells of soil mix or rockwool. Some species, such as A. melanoxylon, can be raised from root cuttings from mature trees. Remove roots about %in (5mm) thick, wash them, and cut into 1–2in (2.5–5cm) lengths. Press horizontally into pots of seed soil mix, cover with more mix, and top with vermiculite

The seeds have hard coats, abrade them with sandpaper or soak in very hot water, then cool for 24 hours before sowing (p.54) at a minimum of 59°F (15°C). Transplant into root-trainers

# ACER MAPLE

CUTTINGS in mid-spring to early summer 11
SEEDS in mid- to late autumn or spring 1
GRAFTING in late winter or mid- to late summer 11
LAVERING in mid- to late autumn or early spring 1

There are deciduous and evergreen species in this large genus. Snakebark species, Acer cappadocicum, and vigorous A. palmatum cultivars such as 'Osakazuki may be raised from cuttings, and species maples from seeds. Layering is simplest if only a few plants are needed, grafting is useful for difficult-to-root cultivars

#### CUTTINGS

Take softwood cuttings in early summer (see p 52). Alternatively, lift a stock plant, bring it into early growth under cover, and take cuttings in midspring to ensure they put on enough growth in the first year to grow well in the spring

#### SELDS

Some species, such as A. griseum, do not set viable seeds unless several plants are nearby. If the winged seeds dry out, soak

for 48 hours before storing or sowing Sow fresh seeds in a seedbed (see p.55) or in pots in a cold frame, or store in a refrigerator (see p.53) and sow in spring Seeds germinate at 50–59°F (10–15°C), but often not until the second spring

#### GRAFTING

Spliced side-veneer graft cultivars of A palmatum and A japonicum in winter or summer (see p.58). Chip- or T-bud A platanoides and A pseudoplatanus (see pp.60–62) in the field in midsummer Moderate success may be achieved if the scion and rootstock are from the same genus, usually the same species Rare species such as A mono may be grafted onto common stocks such as A platanoides. Weak-growing cultivars of A. palmatum thrive only when grafted

#### LAVERING

Many species and cultivars may be simple layered (see p 64), depending on suitable ground conditions

# AESCULUS Horse CHESTNUT, BUCKEYE

There are mostly trees in this genus Root cuttings may be taken from a few species. Take 2–3in (5–8cm) long pieces of root, then treat as for Ailanthus root cuttings (see facing page). Gather and sow the conkers as they ripen (see right). Germination occurs at 50–59°F (10–15°C). You may also space-sow seeds in a raised bed (see p 55).

Increase A happocastanum cultivars by chip-budding them onto seedling stocks 6in (15cm) above soil level (see p 60). A. x carnea seedlings make better stocks than A. hippocastanum, which is too vigorous and forms a poor union except with its own cultivars

GATHERING SEEDS
Gather ripe fruits (here of Aesculus Impocasianum), when they fall to the ground. Remove the hasks, sow at once Alternatively, store in moist peat at 37°F (3°C), then sow individually in pots in late winter



# AILANTHUS TREE OF HEAVEN

CUTTINGS in early winter !
SEEDS from late summer to early autumn !
SUCKERS from late autumn to spring !

Only one species, Ailanthus altissima, is sometimes intentionally cultivated. The winged seeds germinate reachly if sown as soon as they are ripe or cold stratify for 60 days at 41°F (5°C). Female trees, which in some individuals form clusters of attractive red fruits, need to be pollinated by a male plant, which has

foul-smelling flowers. Taking root cuttings from an existing female plant is the best method: take and prepare them as shown below. They should root in 3-4 months. Line out the rooted cuttings in a nursery bed (or pot them) in late spring and plant out after the second winter A. altissima often produces suckers; these should be severed from the tree. If a sucker has a good set of roots, replant it elsewhere

#### TAKING ROOT CUTTINGS OF AILANTHUS



I Choose a tree that is healthy and growing vigorously. Carefully uncover some of the mots (see left) by loosening the topsoil with a fork Look for mots that are about zin (1cm) in diameter. Dig out the soil below the mot



2 t sing primers or long handled toppers remove a section of root at least 12in (30cm long, making a clean, straight cut. Shake off the excess soil but do not wash the root



3 cut the root into 2in (5cm) lengths (see below with the top ends straight and the bottom ends angled so that you know which way up to insert the cuttings. Push each cutting a yield end downward, vertically in a notting medium so that the flat end is covered, just below the surface (see left). Water and label the cuttings, then place in a cool place to root

Anglobent

#### OTHER GARDEN THEES

Acmena Take semi-tope cuttings in late summer as for Metrosideros (see p 84) \$\frac{1}{4}\$ Sow fleshy seeds as for Dracaena (p 79) when ripe or in spring \$\frac{1}{4}\$

ADANSONIA Remove seeds from outer coating when fruits are rupe sow singly at once or in spring in containers (see p.54) in free-draining soil mix at 70°F (21°C) 1
AGATHIS (syn Dammara) Sow seeds at 50–55°F (10–13°C) in early spring 1
AGONIS Sow seeds in spring as for Grevillea (see p.80) 1. Whip or side-veneer graft (p.58)
A. flexilosa Variegata' onto
A. flexilosa seedlings 11
Altocasi Arina Sow seeds (see

p.54) in spring at 59°F (15°C) 1

AMELANCHIER Take greenwood cuttings (see p.52) of cultivars 11. Sow fleshy to and seeds as for Sorbus (see p.90) 1. (See also p.118.)

AMHERSTIA NOBILIS Seeds often infertile sow singly (see p.54) at 70°F (21°C) in spring 1

ANACARDIUM Sow fleshy seeds as for Dracaena (see p 79) in spring a Anacaena (see p 80) a Anacaena Sow seeds in early spring as Eucalyptus (see p 80) a Anacae (syn Chemitaria) Sow seeds fresh (see p.54) in spring or dry in spring at 70°F (21°C) in very fertile soil mix a

AMELANCHIER ASIATICA

# ALBIZIA MIMOSA

CUTTINGS in early to midsummer 111 SEEDS in early spring 1

Most of the trees in this genus (syn Paraserianthes) are quite tender, but the silk tree (Albizia julibrissin) is much hardier (to Zone 6) Saplings flower in three years

Greenwood cuttings (see p.52) yield variable results. Take them with a heel, treat with hormone rooting compound, and insert into rockwool plugs for the best results

In the wild, the hard seed coats withstand long periods of dessication. Gather the seeds from pealike pods and soften their coats in very hot water before sowing, allow to cool for 24 hours. Sow into containers (see p.54) at a night-time minimum of 59°F (15°C). Soon after germination, transplant into root-trainers to avoid disturbing taproots.

# ALNUS ALDER

CUTTINGS in late spring 11
SEEOS in autumn or late winter 1
GRAFTING in late winter 11

Vigorous species, such as Alnus glutinosa, A rubra (syn. A oregona), A x spaethii and their cultivars, can be increased from softwood cuttings (see p.52)

Gather the seeds in midautumn (see below). Store them at 37°F (3°C) in sealed plastic bags for 180 days, then sow (see p.54) in containers to germinate at 50–59°F (10–15°C). Alternatively sow fresh seeds in a raised bed (see p.55). Avoid windy days for outdoor sowing, because the seeds are very light and can blow away eastly.

Whip graft or spliced side-veneer graft (see p 58) cultivars of A glutinosa or A incana onto A glutinosa rootstocks in 3% or 5in (9 or 13cm) pots. Take scions from the previous year's growth If the stock girth is much greater than that of the scion, an apical-wedge graft (see Laburnum,



#### ALDER FRUITS

Aiders bear male and female eathers on one tree Female cathers develop into woody, concline fruits (here of Alnus incana). Gather these when tony turn brown in autumn. Keep the fruits in a warm, dry place until they release the seeds

# ARAUCARIA

SEEDS in early autumn 1

These are curious-looking large trees, including the monkey puzzle tree (Araucana araucana, syn. A imbricata) Male trees have large, conical pollen cones, and females have smaller, round cones that disintegrate after 1–2 years to scatter the seeds. These will not germinate if they dry out

Chill fresh, ripe seeds in a bag of slightly damp peat or sand at 34–39°F (1–4°C) for 3–12 weeks. When the seeds begin to germinate, sow in pots (see p.54) Keep in a bright, frost-free place at about 59°F (15°C). The seed leaves of most species remain below ground as the shoot of adult foliage emerges (hypogeal germination, p.20)

# ARBUTUS STRAWBERRY TREE, MANZANITA

CUTTINGS in late summer to early autumn 111 SEEDS in late winter to early spring [

Most are tree species, including Arbutus andrachne, A. menziesii, and A. unedo. A. x andrachnoides tarely produces fruits in cooler chimates so try semi-ripe cuttings (see p.51). They need high humidity and bottom heat of 64–70°F (18–21°C) to root. Use acidic soil mix

Gather the fruits of other species and soak them for several days in warm water to remove the pulp Store cleaned seeds in moist sand in the refrigerator for 60 days (see p 53)

p.54) and keep them at 60-70°F (15-21°C). If the seeds fail to germinate chilt for two months or leave outdoors in autumn to germinate the next spring

ARBITE'S ENFIDO

The strawberrylike fruits follow the white flowers in autumn and take a year to ripen to red. Gather and clean them as soon as they change color

# BRACHYCHITON BOTTLETREE, KURRAJONG

SEMI-RIPE CUTTINGS in summer \$11
HARDWOOD CUTTINGS in early autumn \$1
SEEDS in spring \$

These are evergreen or decidaous trees Both types of cuttings need humidity and bottom heat to root successfully Sow seeds fresh at 61–64°F (16–18°C) singly into root-trainers or transplant seedlings as soon as possible

# CALOCEDRUS INCENSE CEDAR

Cuttings in law surplied to the surpline III.
Second in spring 4.

There are three species in this genus Take 4in (10cm) semi-ripe cuttings (see p 70), with or without a heel, for best results. They may be set outdoors, but bottom heat of about 64°F (18°C) in a closed case improves rooting, which may take until early summer. Gather ripe, yellow-brown cones in autumn. Store the seeds (see p 72) until spring, sow in containers (see p 54). Keep at 59°F (15°C) to speed germination, but detay transplanting until the following spring.

# BETULA BIRCH

CUTTINGS in midspring to early summer 12
SEEDS in midstammer or late winter 1
GRAFTING in late winter to early spring 14

Only seeds from species of trees in this genus come true, so birches are most often rooted from cuttings or are grafted but care must be taken with the choice of rootstocks

#### CUTTINGS

Take softwood cuttings (see p 52), and feed regularly once they have rooted to

GATHERING BIRCH SEEDS
in midsummer, break a ripe cathin into a plastic
bag. Place the seeds and chaff on a tray and
gently blow off the chaff to leave the seeds behind

ensure they put on sufficient growth in the first season otherwise, they may fail to grow the following spring

#### SEEDS

Gather the seeds (see below), dry, and store them in a refrigerator (see p.53), then sow in containers (see p.54) to germinate at 50–59°F (10–15°C). Fresh seeds may also be sown in a raised seedbed (see p.55). The seeds are very light, so avoid sowing on a windy day.



SELF-SOWN BIRCH SEEDLING
Birches self-sow readily, so look for seedlings in
late spring. Transplant when the seedling (here
of Betula pendula) has 2-4 leaves

#### GRAFTING

Most birches are grafted onto Betula pendula, but incompatibility may be a problem. If possible, use seeding stocks of B nigra for ornamental species such as B. albosinensis. B ermanii, and B utilis

Whip graft or spliced side graft the plant (see p 58). To avoid sap bleeding at the union, keep the soil mix on the dry side until the scion buds break. Pot on once the graft takes so that the scion grows well in the first season.



AFTERCARE OF GRAFTED BIRCH TREES
Encourage caliusing of grafted plants (here
Betula utilis van jacquemontii) by piacing them
in a "hot pipe" (see p 109)

# CARICA PAPAYA

SEEDS in spring 14

This is really an arborescent herb. Both a male and female plant, or a bisexual pant, are needed for the commonly grown species, Carica papaya, to fruit Sow the seeds fresh (see p.54) or in spring in a seedbed or in tube pots to avoid disturbing the roots; they should germinate readily at 64°F (18°C). Root suckers may be detached in early spring or early autumn.

# CATALPA INDIAN BEAN TREE

GREENWOOD CUTTINGS in early to midsummer 11 Root outlings in early to midwinter 1 Seeds in early to midspring or in autumn 1 BUDDING in midsummer 11

Greenwood cuttings (see p.52) of these trees have limited success, take them with a heel and root in rockwool plugs. Root cuttings are best taken only from species, as for Ailanthus (see p.75). Gather the seeds (see below) and store dry in sealed plastic bags at room temperature. Sow (see p.54) at 59–70°F (15–21°C)

Chip-bud (see p 60) C bignonioides and C x erubescens cultivars 6m (15cm) above soil level onto pot- or field-grown

stocks of C bignonioides C bignonioides 'Aurea' may be top-worked budding 2–3 buds onto a 6ft (2m) stem to create a standard

Catalpa steppods
Gather the green pods
to trever point
brown before they
split and shed then
seeds. They may
sput when discor
you can cut them open
to extract the seeds

# CEDRUS CEDAR

SEEDS in spring 1
GRAFTING in late summer or mid to late winter 11

The species may be grown from seeds gathered from three-year-old cones (see pp 71–2). Break the wings off the seeds before storing (see p.72), cold moist stratify (see p.54) for two weeks before sowing in pots (see p.54) at a temperature of about 59°F (15°C).

Graft cultivars, especially C libant 'Glauca', onto two-year-old seedlings such as C deodara. Keep the stock in active growth until midsummer, spliced side-veneer graft (see p.73) a scion from vigorous shoots of the new growth.

# CERCIS REDBUD



CL IN MAGRICA COM

WEST OF S

CUTTINGS in early to midsummer [1] SEEDS in midwinter [1] GRAFTING in midwinter [1]

The trees in this genus are not easy to propagate. Try taking greenwood cuttings as for Acacia (see p 74)

Gather seeds from mid- to late autumn and soak (see right). Sow in containers (see p.54) and germinate at 59–70°F (15–21°C) It is possible to apical-wedge graft scions onto one-year-old pot-grown

seedlings of C. siliquastrum, but these may be difficult to obtain Bring them under cover a few weeks before grafting as for Laburnum (see p 82)

#### CERCIS SEEDPODS

These trees belong to the pea jamily and produce flattened seedpods (here of Cercis siliquastrum) and very hardcoated seeds. Soak the seeds in very hot water and coot for 24 hours. Straigh in the refrigerator for 8-12 weeks, then sow

#### OTHER GARDEN TREES

Arbisia Take semi-ripe cuttings (see p.51) in late summer \$1. Sow fleshy seeds as for Dracaena (p.79) in spring \$. Arbicarus Take semi-ripe cuttings (see

Artocarpus Take semi-ripe cultings (see p.51) with bottom heat of 70°F (21°C) in late spring 1

Athrotaxis Semi-ripe cuttings (see p.70) in summer ‡ Sow seeds (pp 54–5) in seedbed or pots in late winter or early spring ‡ Austroceons's chilensis. Semi-ripe cuttings (see p.70) in summer ‡‡ Sow seeds (pp.54–5) in seedbed or in pots in late winter or early spring ‡ Backingt sta. As for Eurolyptus (see p.80) ‡ Banksia. See p.119

BARKLYA Sow seeds fresh in autumn or scarify to sow in spring (see p 54), takes 8–10 years to flower 11. Take semi-ripe cuttings (p 51) in late summer to autumn 1. Air layer (p.64) any time 11.

BAUDISIA Sow seeds as for Acade (see p.74) in spring 4. Whip graft (p.58) or spliced side-veneer graft (p.58) in spring 44. BERTHOLLI HA EXCEUSA. Remove seeds (Brazil nuis) from husk, sow singly in free-draining soil mix at 70°F (21°C) in spring 4. Whip graft (see p.58) or spliced side-veneer graft (p.58) in early spring 44.

BIXA ORITIANA. Sow seeds as for Action (see p.74), but at 70°F (21°C) §. Spliced side veneer graft (p.58) or whip graft (p.58) scions taken from flowering three in spring to obtain flowering plants more quickly – in 1–2 years, instead of five §§

BOLUSANTHUS SPECIOSUS Sow seeds as for Acacia (See p. 74), but at 70°F (21°C ) ]. BOMBAX Remove seeds from bask, sow singly in pots (see p. 54) in free-draining soil mix at 70°F (21°C) as soon as ripe [ BROUSSONETIA Take greenwood cuttings as

for Magnalia (see p.83) from early to midsummer 11. Sow seeds as for Cornus (p.78) in spring 1. Spliced sideveneer graft (p.58) or

> BERTHOLLETIA EXCELSA SEEDS AND HUSK

whip graft (p 58) B papyrifera cultivars \$\frac{1}{2}\$
Browsea. Take 6ft (2m) hardwood cuttings as for Saltx (see p 89) \$\frac{1}{2}\$. Sow seeds as for Acacia (p.74), but at 70°F (21°C) \$\frac{1}{2}\$.

Caesaceinia Seeds as for Acacia (see p 74) \$\frac{1}{2}\$.

Take softwood cuttings (p.52) in spring \$\frac{1}{2}\$.

Spliced side-veneet graft (p.58) or whip graft (p 58) in spring \$\frac{1}{2}\$.

Callings Sow seeds (see p 54) at 55-64.

(13-18°C) in spring \$\frac{1}{2}\$.

Calone subject Take semi-ripe cuttings (see p 51) in late summer or early autumn \$\frac{1}{2}\$. Sow seeds as soon as ripe (p 54) at 70°F (21°C) takes quite a few years to flower \$\frac{1}{2}\$.

Carrieds. Take greenwood cuttings (see p.74) \$\frac{1}{2}\$.

takes quite a few years to flower [ CALM RNIA Seeds as for Acacia (see p.74) ]. CARMNOS Take greenwood cuttings (see p.52) in early summer []. Sow seeds in seedbed (p.55) in autumn []. Whip graft (p.58) in winter, top-work C. betalus for a weeping standard [].

Catera. Sow seeds as for Juglans (see p.81) | Whip-and-tongue graft as for Juglans | 111 | Casera Sow seeds as for Acadia (see p.74) | Casera Sow seeds as for Acadia (see p.74) | Casera Sow seeds as for Acadias (see p.74) | Chip-bud as for Malus | 1

CASUARINA Take semi-ripe cuttings as for Microsideros (see p.84) §. Sow seeds as for Acada (p.74) §.

CEBA Tease seeds from silky fiber (kapok of seedheads, sow singly in containers (see p 54) in free-draining soil mix at 70°F (21°C) in spring 1

CELLIS Sow seeds as for Zelkova (see p.91) & Whip graft as for Betula (see Jacing page) onto seed-raised stocks of C occidentalis \$\frac{1}{4}\$ CERATURIA Sow seeds as for Acacia (see p.74) \$\frac{1}{4}\$. Bud cultivars as for Citrus (p.78) as spring or midsummer \$\frac{1}{4}\$.

CERCIDIPHYLLUM JAPONICUM Sow seeds as for Acer (see p.74) 1. Graft form a pendulum as for Corylus avellana Pendula (p.78), unto seed-raised stock 11.

Simple layer as for Magnolia (p.83) 1



# CHAMAECYPARIS CYPRESS



CUTTINGS in late summer to midautumn !
SEEOS in spring !
GRAFTING in late winter !!

Propagate species of

Chamacoparis dwarf or slow-growing cultivars do not root freely, so they must be grafted

#### CUTTINGS

Cuttings root at almost any time, but 4-6in (10-15cm) semi-ripe cuttings (see p.51) are best, provided the base is not too woody. Insert into rooting medium and keep humid on a mist- or covered bench or under plastic film (see p.44)

with bottom heat of about 68°F (20°C), but no higher, to promote rooting. This may take 6-9 months

#### SEEDS

Extract seeds in autumn from one year old cones, store in the refrigerator for 60 days at 41°F (5°C) until sowing (see p.72) with bottom heat of 59°F (15°C) Transplant the seedlings in midsummer

#### GRAFTING

Spliced side-veneer graft cultivars such as C lawsoniana 'Lutea' and C obtasa 'Crippsii' onto slightly thicker two-year-old seedlings of C lawsoniana (see p 73) With bottom heat of 68°F (20°C), the graft should callus after several weeks.

# CRATAEGUS HAWTHORN

SEEDS in midautumn or late winter 1 Budoing in mid- to late summer 11

Gather fruits of the many trees in the genus in midautumn, the best time is while they are still green and before any germination inhibitors develop. Soak them in warm water for several days to clean the flesh off the seeds. Sow into containers (see p.54) and place in a sheltered site, or store in a refrigerator (see p.53) and sow in late winter Germination occurs at 50–59°F (10–15°C) but is erratic, so keep the seeds until the second spring

It is quicker to graft if only one or two plants are required. Several species make good seed-raised stocks at two or three years old, such as Crataegus crusgalli, C. laevigata (syn C. oxyacantha) or C. monogyna. Chip-bud in the field bin (15cm) from soil level (see p.60)

# CITRUS

COTTINGS in summer II
SEE03 in summer II
GRAFTING in late summer or early autainn III

Citrus cultivars are grafted onto rootstocks for vigor, disease resistance and early crops. Cuttings or seeds are worth a try, but these may be prone to phytophthora root diseases

#### CUTTINGS

Some citrus, for example lemons (Citrus limon), root more easily than others from semi-ripe cuttings (see p 51)

#### SEEDS

Unusually, citrus produce seeds with several embryos, some of which are asexually derived (apomiciic), so the seedlings are clones of the parent. Sow seeds in pots (see p 54), weed out puny or very vigorous sexual seedlings. The plants should flower in seven years

#### GRAFTING

Citrus is often grafted onto a Japanese bitter orange seedling (Poncirus trifohata) Take a chip-bud (see p.60) and put under the bark as in T-budding (see p.62)



LEMONS (CITRUS LIMON)

As well as lemons, Citrus includes grapefruits, limes, tangerines, oranges, kumquats, and then hybrids; they are all quite tender

# CORNUS Dogwood

CUTTINGS in late spring or early summer \$\$.
SEEDS in late winter or early spring \$\$\$.
GRAFTING in late wanter \$\$\$\$\$

There are small, deciduous or evergreen trees in this genus. Those with variegated foliage are best taken from softwood cuttings, as for maples (Acer) (see p. 74) or for quicker results grafted. Use seed-raised Cornus florida or C. kousa as rootstocks with whip (see p. 58) or spliced side-veneer graft (see p. 58). Raise C. mas and C. nuttallii from seeds (see below).

and strawberry like, such as those of Cornus Porlock (above) Gather the ripe triats and treat the seeds as for Arburus (see p. 76

found from s some are cable

# CORYLUS HAZELNUT

CUTTINGS in early and midsummer [].
SEEDS in late winter [].
GRAFFING in late winter [].
LAYERING in mid- and late autumn [].

Trees in this genus include the nutbearing Corylus avelland and C. maxima, which may be raised from seeds (see p.54). Most of their cultivars are usually propagated by greenwood cuttings (see p.52). They can also be simple layered (see p.64) from stock plants, cut back the stock plants hard in early spring of the previous year to obtain vigorous shoots for layering

Most hazels may be grafted onto twoyear-old C. avellana seedlings or cuttings

# CRYPTOMERIA

JAPANESE CEDAR

CUTTINGS in fale summer to early auturin | SEEDS in spring | GRAFTING in late winter | | |

Root 3-5m (8-13cm) semi-ripe cuttings of this single species as for Chamaecyparis (see above). This is an unusual comfer in being able to grow new shoots from the base if cut down (coppiced), the shoots will root readily as cuttings

The solitary female cones ripen to brown, gather the seeds in autumn (see p 71). Store dry, then stratify in damp peat in the refrigerator for three weeks before sowing (see p 54). Bottom heat of 59-68°F (15-20°C) aids germination

Some dwarf forms do not have sufficient cuttings material, spliced sidevencer graft (see p.73) scions onto potgrown rootstocks. Keep at 68°F (20°C) for a few weeks until the graft calluses



HAZELNETS

Gather the nots as soon as they fall, store in moist peat at 37°F (3°C) for 2-6 months, and sow into individual containers

by whip (see p.58) or spliced side-veneer techniques (see p.58). C avellana Contorta' and 'Pendula' must always be grafted, whip or apical-wedge graft (see p.58) the scion onto a 6st (2m) stem of C. maxima or C avellana. Cut out any suckers from the stock as they appear

# X CUPRESSOCYPARIS

CUTTINGS in mid- to late summer 11

Most commonly cultivated are cultivars of the Leyland cypress (x Cupressocvparis leylandii, syn. Cupressus leylandii). For best results, take 6in (15cm) semi-ripe cuttings (see p 70) from slightly shaded basal shoots, treat as for Chamaecyparis (see facing page)

# DAVIDIA HANDKERCHIEF TREE

SEEDS in spring !!!

Davidia involucrata is also called the dove or ghost tree. Clean ripe fruits, sow (see p.54) at once, singly, keep at 70°F (21°C) for three months, then move outdoors. Seeds are doubly dormant and may not germinate for two winters. Flowers in ten years.

# CUPRESSUS CYPRESS

CUTTINGS in the winter or law summer ##
SEEOS in late winter or spread ##
GRAFTING in late winter ##

Most of the cultivars of these trees may be rooted from cuttings (see p 70). For best results, take 3-4in (8-10cm) green shoots in late winter and root under mist with bottom heat of 68°F (20°C). Cuttings may also be rooted under cover in summer.

Ripe, two-year-old cones are difficult to identify. Look for a branch bearing three sizes of cone and choose the largest, or find cones borne on shoots well back from the growing tips. Seeds (see p 54) germinate best at 59°F (15°C)

Certain cultivars do not root easily from cuttings, such as C macrocarpa 'Goldcrest', these may be better spliced side-veneer grafted (see p 73)

#### OTHER GARDEN TREES

CHRYSOPHYLLIA Root hardwood cuttings (see p. 50) of well ripened shoots in high heat and hamidity in late summer to autumn I. Sow seeds (p. 54) in spring I Christmanour M. Take semi-ripe cuttings (see p. 51) at any time I. Extract seeds from Beshy fruits in spring, sow immediately (p. 54) at 55–64°F (1.3–18°C) I

CITBAREXYLOM: Take semi-ripe cuttings (see p. 51) at any time 4. Sow seeds as for Chamamanian 4.

CLADRASTIS Take root cuttings as for Acadia (see p.74) §. Seeds as for Cercis (p.77) § CLETHRA. Take semi-ripe cuttings of evergreens as for Arhutus (see p.76) §§. Take greenwood cuttings of deciduous species (p.52) in early summer §§. Sow seeds as for Rhododendron (p.138) §. Layer as for Magnolia (p.83) §

COCCOLOBA Extract seeds from ripe fleshy fraits, sow at once (see p.54) at 70°F (21°C) & simple layer ripe stems at any time (p.64) & COLVILLEA RACEMOSA. Seeds often infertile sow (see p.54) as soon as ripe singly in containers at 70°F (21°C) &

CORDIA Take semi-ripe cuttings (see p 51) at any time 4. Sow seeds (p.54) when ripe 4 CORDYLINE As for Dracaena (see right) 4 CORDYLINE Sow seeds as for Dracaena (see right), 4. Semi-ripe cuttings, primarily of variegated forms as for Arbutus (p 76) 44

+ CRATAECOMESPILI/S Whip-and longue graft as for Maius (see p.84) 11. Chip-bud as for Crataegus (facing page) 1.

Crataegus (Jacing page) 1.
CENODENDRON Take semi ripe cuttings as for llex (see p 81) in late summer 11
CYDONIA Whip-and-tongue graft, chip-bud, or T bud onto clonal cydonia

rootstocks as for Pyrus (see p.88) 11 Cyrnostandra. Take softwood cuttings (see p.52) in spring 1. Sow seeds as for Dracaena (right) in spring 1.

DACRYON M. Take semi-ripe curings (see p. 70) from mid- to late summer [4]. Sow seeds (p. 54) in mid- to late summer [4]. DELONIX. Sow seeds as for Acadia (see p. 74) but at 70°F (21°C) [4].

Dilitation Extract seeds from fleshy fruits when ripe sow (see p.54) at 70°F (21°C) & Dieserales Male and female persummons needed for seeds, sow as soon as ripe after removing seed coats (see p.54) \$\frac{1}{4}\$. Whip-and-tongue graft (p.59), chip-bad (p.60) or I-bad (p.62) cultivars onto seedling stocks mid to late summer \$\frac{1}{4}\$.

in late summer 41. Sow seeds as soon as ripe in spring (p 54) at 70°F (21°C) 4 ELAEOCARPUS. Take semi-ripe cuttings (see p 51) in late summer 44. Sow seeds as for

DOMBEYA Take semi-ripe cuttings (see p 51)

Dracaena (right) in spring (ELECTHEROCOCCUS (syn. Aconthoponax)
Take softwood cuttings (see p. 52) in late spring (L. Take root cuttings as for Ailanthus (p. 75) (L. Sow seeds as for Sorbus (p. 90) (L. EMBOTHRIUM Take root cuttings as for Robina (see p. 89) (L. Sow seeds as for

Grevillea (p.80) 1. Separate suckers as for

Populus (p 86); pot suckers at 50°F (10°C) ‡ ERIOBOTRIA Sow loquat seeds fresh (see p.54) in late spring ‡ Chip-bud p.60) or T-bud (p 62)

onto clonal cydonia rootstock in mid- to late summer !

CYDONIA OBLONGA

# DRACAENA



CUTTINGS any time !
SEEDS in early spring !

The treelike species
of this genus are grown
for their foliage
Variegated cultivars
must be increased from
cuttings to retain the

war route Tricolor cuttings to retain the variegation. It takes three to five years to obtain a good sized plant

#### CUTTINGS

Take stem cuttings from healthy, strong sideshoots and split, as shown below, for the optimum number of new plants. Alternatively, insert whole sections of stem vertically Leaf-bud cuttings also root well (see below). Instead of sharp sand, you may use a free-draining soil mix or rockwool. Cuttings root within 8–12 weeks.

#### SEEDS

Extract the seeds from the berries (see p.53) and sow in containers (see p.54) at 68-80°F (20-25°C). Germination should take 4-6 weeks. Transplant the

seedlings into individual pots, once settled, grow on at 59°F (15°C)



entting just above a node. Fill a pan with moist sharp sand, then insert the stem vertically so that it is half buried. Trim the leaf by half its length to avoid moisture loss. Water, label, and keep in bright shade at 64–70°F (18–21°C) until rooted.

c se a half pot or pan, too great a depth of soil mpc or sand may lead to rot Service of the servic

STEM CUTTINGS Remove sections of a

healthy stem, each with one or two nodes. Slice each section in two lengthwise with a sharp knife if the pith is moist, root in moist sharp sand to avoid rot. If it is dry, use a free-drawing rooting medium. Lay the cuttings wounded sides down. Label, then treat as leaf bud cuttings

# EUCALYPTUS GUM

SEEDS in early spring |

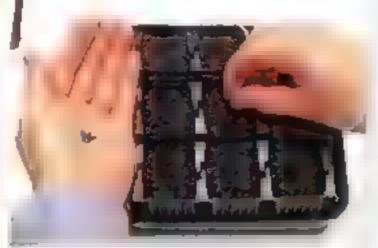
The fast-growing trees in the genus are suitable for Zones 9-10. In the wild the woody seed capsules persist on the tree, so they can be gathered any time If they do not split easily, the seeds may be immature, Eucalyptus seeds benefit from a cold period at 37-41°F (3-5°C)

> for two months (see p 54). They dislike root disturbance, so transplant or sow into roottrainers (see below) Seeds germinate quickly at 59-68°F (15-20°C) Plant out seedlings in 12-15 months



EXTRACTING STEDS

remer penedo sed equales there of Eucalyptus pauciflora subsp naphophila) in a warm dry place for 1-2 weeks until they split open to release seeds and tine brown chaft



SOWING SEEDS IN ROOT-TRAINERS Fill the mot-tramers with solless seed mex. Sow a pinch of seeds into each cell. Lightly coverwith steved mix and a thin layer of fine grit Water and tabel. Then each cell to one seedong

# FAGUS BEECH

SEEOS from late summer to late autumn or in

GRAFTING in late winter or early spring \( \frac{1}{4} \)

The simplest way to grow these largegrowing trees is from seeds. Gather the nuts when ripe and sow at once outdoors (see p.55), or store in the refrigerator for six weeks before sowing in late winter (see p.54) to avoid losing seeds to rodents. Germination is at 50°F (10°C)

Two- or three-year-old seedlings of the European beech, Fagus sylvatica, are often used as rootstocks for whip or spliced side grafting (see p.58). Beeches have thin bark, so spliced side-veneer grafting (see p 58) is also suitable. Graft at soil level for a neat graft union - a top-worked graft on a tall stem may look ugly. Tie the growing scion into a split stake so that it grows straight. Stake weeping forms with a sturdy stake of the desired length of the mature stem

# FICUS FIG



HAROWOOD CUTTINGS in late autumn or late winter 🕻 SEMI-RIPE OUTTINGS all year LEAF-BUD CUTTINGS all year AIR LAYERING IN Tale autumn or spring 1

Ficars clustre t Doeschen'

A few of the tree species are fairly hardy, such as the edible fig. (Figus carica), but most are tender Figs may be increased from the appropriate type of cutting, but air lavering is easy if only one or two plants are required.

#### CUTTINGS

Take hardwood cuttings of f. carica tie into hundles (see p.51), and keep in frost-free conditions in autumn, large cuttings up to 3ft (90cm) long may be rooted direct. In winter, root standard cultings in pots at 50-59°F (10-15°C). Semi-ripe cuttings (see p 51) of tender evergreens can be taken all year Species with thick stems, such as the Indian rubber plant, F clastica,

may be grown from leaf-bud cuttings (see below) Rolling the leaf reduces moisture loss. It should produce a decent-sized pot plant in two years

#### AIR LAYERING

This can be done on a majure plant if conditions are conducive to rooting - that is, in controlled humidity at 59-68°F (15-20°C) Layer a stem (see p 64), after three months, if it shows signs of drying out, mist spray the root bal-

#### LEAF-BLD CUTTING

Using a sharp knife or primers, cut straight deross a stem just above a node and Im (2 Sem) below the node Keeping the waxy side outermost roll the leaf to form a cyttader secure with a rubber band, and por one softless porring mee. The leaf node should sit on the soil mor sicrace. Support the cutting with a split stake to sign the rolled leaf. Keep monid at 68°F (20°C) and I monted

# FRAXINUS ASH

SEEDS in mid | late or tome 1 GRAFTING IN Tale will alread that is spring [1].

Seeds of these trees are doubly dormant so they need a period of warm moist stratification (see p.54)

Line out one-year-old seedlings of Fraxinus excelsior in a nursery bed and use as rootstocks for whip-and-tongue grafting (see p 59) after another 1-2 years. Graft close to the soil just before the buds break in spring. Top-work Pendula' at the desired height onto fouryear-old stocks. Alternatively, whip graft (see p.58) onto pot-grown stocks

# GINKGO MAIDENHAIR TREE

CUTTINGS in late spring to early summer 111 Seeds in late winter 1 GRAFTING in late winter #

There is a single species, Ginkgo biloba, a male and female tree are needed to produce seeds. The plumlike fruits of the female tree have an unpleasant smell when ripe Gather these in mid-autumn and clean off the pulp. Wash the nutlike seeds with a mild detergent to remove germination inhibitors, then store in the refrigerator for 30-60 days before sowing outdoors (see p.54). Plants may be raised from softwood cuttings (as for Betula, p 76) or by grafting, using a whip-andtongue (see p.59) or spliced side-veneer graft (see p.58)

# GLEDITSIA HONEYLOCUST

SEEOS in late autumn 🌡 GRAFTING in late winter to early spring 111

Young plants of these trees are prone to cold damage. Scarify the seeds (see below) before sowing (see p.54) to germinate at 50-59°F (10-15°C) Whipand-tongue graft cultivars outdoors as for Fraxinus (see left) or use a spliced side graft (see p.58)



Preparing Gleditsia seeds for sowing Soak seeds in warm water for 48 nears. Mix with an equal volume of moist sand in a plastic. bug and chill at 37% (3°C) for 2-3 months

# GREVILLEA STIKY OAK

Seeds in late winter |

Only Grevilled robusta germinates readily; scarriy or soak the seeds (see p 54) of other species for 48 hours before sowing, or stratify for 30 days at 41°F (5°C). Sow the seeds in containers and cover thinly with vermiculite Germination occurs at 50-59°F (10-15°C), the seedlings grow quickly

#### ILEX HOLLY



HAROWOOD CUTTINGS in automit to midwinier 11 SEMI-RIPE CUTTINGS in late summer to autumn 11 SEEDS in early spring 11 GRAFTING in spring, late summer or early autumn 1 LAYERING in spring 1

Barcarica

There are many useful

trees (and shrubs) in this genus. Most root readily from cuttings If only a few plants are needed, try layering. Hollies serf-sow freely in the wild and will germinate just as readily, if slowly (sometimes taking three years), in cultivation. Grafting is feasible, but is useful only for creating a standard.

#### CUTTINGS

Take semi-ripe (see p 51) or hardwood (see p 50) siem cuttings around 3in (8cm) long, with the top two leaves intact and a %in (2cm) basal wound to stimulate rooting. This may take up to three months.

Semi-ripe cuttings of easily rooting llex aquifolium can be taken a little early but remove the soft tips. For deciduous species, such as I. verticiliata, take cuttings in early or midsummer and do not wound the cuttings, they should root in 6–8 weeks. Provide bottom heat for hardwood cuttings taken in winter Cuttings of evergreens may suffer leaf

drop, caused by wet soil mix raising the humidity under cover. If this happens, discard the cuttings

#### SEEDS

Hollies are usually unisexual, for seeds, you need a berry-bearing female and a male nearby to ensure polination. Gather the berries in winter, clean off the flesh (see p 53), and sow at once. Alternatively, store the seeds in a warm, moist place to allow the embryos to mature. Then chill the seeds in moist.

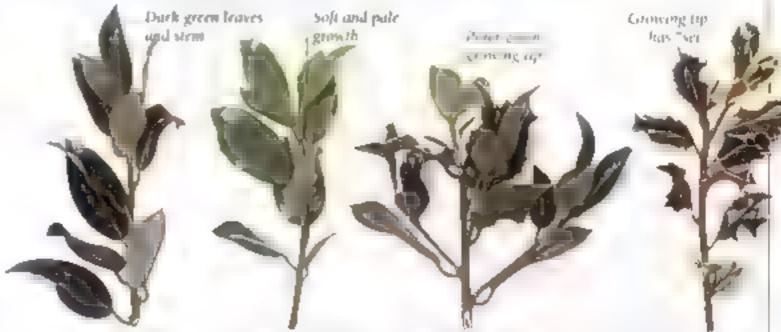
soil mix in the refrigerator (see p 5.3) to break their dormancy before sowing outdoors in a seedbed (see p 5.5)

#### GRAFTING

Chip-bud (see pp 60-1) three buds of the scion plant onto 1 aquifolium at the desired height for a standard plant

#### LAYERING

Chose a flexible, vigorous young shoot that is close to the ground, then simple layer it (see p 64)



STAIL RIPE SHOOT

SOLEWOOD SHOOT

SHOOT IN GROWIN

BARDWOOD SHOOT

SELECTING HOLLY SHOOTS FOR CUTTINGS
Holly shoots darken as they ripen, so avoid
softwood shoots with lighter green leaves. Look
to a crownal built of a bas stopped growing if

the bud is pale green, the growth hormones are stall concentrated at the tip rather than at the stem where they would help the cutting to root

# JUGLANS WALNUT

SEEDS in mid- to late an anin a GRAFTING in early spring 411

Ornamental walnuts are raised from seeds. Gather the ripe fruits, clean off the green, fibrous husks, and sow the "nuts" immediately, or stratify for 120–190 days at 41°F (5°C). Sow in a seedbed (see p 55) or into root-trainers covering the seeds with 1 in (2.5cm) of soil mix and #in (3mm) grit. Germinate

at 50 1 10°C) Plant out seedlings in 3-5 years

Cultivars of Juglans regia
and J nigra, grown for their
edible nuts, are usually whipand-tongue grafted (see p.55)
Use 2-3-year-old pot-grown stocks
of J regia or J. nigra; keep cool
and dormant until 7-10 days before
grafting to avoid sap rising too quickly

Use a slightly narrower scion than the stock so the thinner scion bark will align with the stocks cambium more easily

RIPE WALNUTS

Wathats are stone fruits not trumats. The husks blacken and disintegrate on the tree to release the ripe "mats." Gather the fruits while still green and remove the hasks

#### OTHER GARDEN TREES

Cuttings as for Acer (see p.74) 11
Seeds as for Utmus (p.91) 1.

E. REPHIA Take softwood
Cuttings as for Stewartia (see p.90) 11. Take semi-ripe cuttings as for Arbitus (p.76) 11. 5 w seeds as for Stewartia (p.90) 1.

E. PTELEA Sow seeds as for Stewartia (p.90) 1.

E. PTELEA Sow seeds as for Stewartia (p.83) 1.

F. RMIANA Remove seeds when ripe from outer coating: sow singly (see p.54) in free-draining.

FRANK, NIA ALATAMARA. Take softwood cuttings as for Accidisee p.74) 41. Sow seeds as for Stewartza (p.90) §.
GEDERA. Scarify fresh seeds and sow in autumn (see pp.53-4) 44. Gordonia. Semi-ripe cuttings as for Arbutus (see p.76) 48. Sow seeds as for Stewartia (p.90) §. Gymnocladus. Take root cuttings as Acacia (see p.74) 44. Sow seeds as for Acacid §. HAKEA. Sow seeds as for most

Grevilleds (see Jacing page), avoid disturbing roots & HALESIA. Take softwood cuttings as for Magnolia (see p.83) & Sow seeds as for Davidia (p.79) & Honesia. Take greenwood cuttings (see p.52) of deciduous trees in early to midsummer & Take semi-ripe cuttings (p.51) of evergreens in late summer or early autumn & All cuttings need mist and bottom heat of 10°F (21°C). Sow seeds as for Grevillea robusta (facing page) &

HOVENIA Abrade fresh seeds then soak in water for 48 hours before sowing outdoors (see p.55) in autumn in cool climates, or refrigerate moist for 90 days, then sow at 50°F (10°C) in spring 11. Hymthosperia M Playem Take semi-ripe cuttings as Hoheria 11. Sow seeds as for Grevillea robusta (see facing page) 1. Jacaranda Take greenwood cuttings as Acacia (see p.74) 11. Sow seeds as for Acacia 1.

# JUNIPERUS JUNIPER



houneras

7.7.4

CUTTINGS in late summer aurumn or in late winter [1].
SEEDS at any time [1].

There are shrub and tree species in this genus (syn. Sabina). To succeed, cuitings must be taken from suitable shoots. Raising

junipers from seeds is slow, but it yields plants of both sexes

#### CUTTINGS

Choose strong, juvenile shoots that are still green at the base; juvenile leaves are needle like. Treat as semi-ripe cuttings (see p 70) to root by the next summer. In

late winter, root cuttings in humidity with bottom heat of about 68°F (20°C).

#### SEEDS

Jumpers of both sexes are needed to produce female cones with viable seeds, these are berrylike when ripe and often blackish purple or blue J. recurva and most jumper cones ripen in two years, J. virginiana cones in the first autumn, and J. communis cones after three years Clean off any fleshy coating, then sow seeds in pots (see p.54). Germination takes 2–5 years. Expose the seeds to cold in winter and heat in summer, but keep the soil mix moist. Pot the slow-growing seedlings in their second year.

# LABURNUM GOLDEN CHAIN TREE



Labramon agunan

CUTTINGS in late automo 1
SEEDS in early spring 1
GRAFTING in early spring 11
BUDDING in midsummer 111

Hardwood cuttings of these trees can be very successful Seeds are also useful for raising the two species. For a

tree that will flower in three years, try grafting or budding.

#### CUTTINGS

Take 8–12m (20–30cm) hardwood cuttings (see p.50) with a heel or at the union of the current and last seasons growth. Cutting into the pithy tissue of new growth hinders rooting. Root in a slit trench with coarse grit in the base, or in bundles in a cold frame (see p.51), then pot in spring

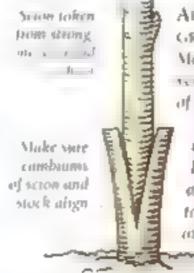
#### SEEDS

Gather the pealske seeds from ripe pods and treat as for Robinia (see p 89)

#### GRAFTING

Grow on two-year-old Laburnani anagyroides in a nursery bed for a year to use as rootstocks for chip-budding (see p 60). Insert the buds 3-4in (8-10cm) above soil level. Train the new growth up a stake, then stop it at the desired height (according to whether it is to be a multi- or single-stemmed tree) to allow it to branch. It is faster to top-work three buds of the pendulous form at 5-6ft (1 5-2m) onto three- or four-year-old stocks (see box, p 57).

Apical-wedge grafting (see p 58) is often more successful than budding. Cut down a two-year-old stock to just above a bud at soil level to draw the sap up the stem, or graft pendulous forms onto 5–6ft (1 5–2m) tall stocks. Protect newly grafted plants from cold, if necessary



APICAL-WITE I
GRAITING LABLENCY
Make a fer 2 to a
rette al cut me the crace
of the stock. Take a scion
I—I buds long from the
new growth, make two
Int (2 5cm) sloping cuts
of the base of the scien
to form a wedge insert
onto the cut in the stock

# LARIX LARCH

Carrings in mashing at SEEOS in late winter to spring a GRAFFING in late winter or late stimmer 111

Female usually purple, cones of these trees ripen in the first year to brown, but old cones may have a few viable seeds (see p.71). No stratification is required bottom heat of about 59°F (15°C) aids germination. Seedlings grow fast and at two years may be used as stock plants for softwood cuttings (see p.52), they noot readily if kept humid

Cultivars and rater species that do not set seeds are best spliced side-veneer grafted (see p.73). For stocks, pot two-year-old seedings in spring, keep warm and dry in winter for three weeks so they start into growth without forming too much sap. Most shoots may be taken as scions while fully dormant in mid to late winter; store them in a plastic bag in a refrigerator. Keep the grafted plant rather dry at 64–68°F (18–20°C) until a callus forms and the buds break.

# LIQUIDAMBAR SWEET GUM

Seedlings of these trees vary greatly, hence the wide range of cultivars. Extract seeds from the spiky, round fruit clusters and sow them outdoors (see p.55) or store in moist vermiculite (see p.53) for two months before sowing and keep in a bright spot with a night temperature of 59–68°F (15–20°C) for germination in six weeks

Most cultivats root well from greenwood cuttings (see p 52), but for large vigorous trees, especially of variegated forms, it is better to whip or spliced side graft them (see p 58). For rootstocks, use two-year-old pot-grown species. Plant out grafted trees after five years. A low branch may be simple layered (see p.64).

# LIRIODENDRON

TULIP TREE, YELLOW POPLAR



4. 19

Carrings is mulscaning II
SEEDS in late database or are
winter I
GRAFTING in late winter II

Sowing seeds is the simplest way to raise the two species in this genus, but seed viability

fruits in midautumn, break open, and sow the secus outdoors (see p.55) or store in the refrigerator (see p.53) for 60–90 days, then sow and germinate at 59–68°F (15–20°C) in six weeks

Take greenwood cuttings (see p 52) from vigorous shoots. To propagate a cultivar, such as Liriodendron talipifera Fastigiatum', whip or spliced side graft (see p 58) onto a pot-grown two-year-old seedling. Plant out in 3-5 years.

# MACLURA OSAGE ORANGE

BARDWOOD CUTTINGS in late an umn or in late writter 1

SEEDS in mid- to late automit \$

Only Machina pomifera is commonly grown. Extract the seeds from the fleshy fruits, soak in water for 48 hours and keep moist for eight weeks in the refrigerator before sowing (see p 54). Cuttings are slow to root. If taking hardwood cuttings immediately after leaf fall, store in bundles in sand (see p 51) until late winter, then insert into individual pots and supply bottom heat of 59–68°F (15–20°C). Take root cuttings as for Acacia (see p 74).

# MAGNOLIA

Semi-AIPE CUTTINGS in carly to midautumn 11
SOFTWOOD CUTTINGS in rate spring to early
summer 11

GREENWOOD CUTTINGS in early to impleasumer \$\frac{1}{4}\$
SEEDS in mid- to late autumn \$\frac{1}{4}\$
GRAFFING in late winter to early spring \$\frac{1}{4}\$
BUDDING in mid- to late summer \$\frac{1}{4}\$
LAVERING in late autumn to early spring \$\frac{1}{4}\$

There are mostly trees in this genus, plus a few shrubs. Cuttings may be taken from plants with suitable shoots. Grafting is often the best option if only a single plant is needed and for trees that do not root readily. Seeds and layering are easier, but slower

#### CUTTINGS

Take soft- and greenwood cuttings (see p.52) from 3-5in (8-13cm) new shoots of vigorous, deciduous magnolias

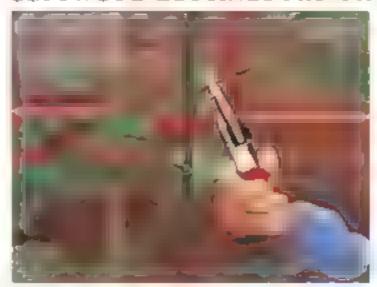
Commercially, stock plants are grown under cover for softwood cuttings in late spring. This allows time (8–12 weeks) for cuttings to root and put on some growth before winter in colder climates. A stock plant bought in spring from a garden center is as good because it will probably have been grown under cover Take nodal stem-tip cuttings (see above), and root in humid shade: young leaves scorch easily Bottom heat of 64–70°F (18–21°C) helps. Liquid-feed rooted cuttings (so they are ripened by autumn and more likely to grow away in spring) and overwinter in a frost-free place

Take semi-ripe cuttings (see p 51) of evergreen species and cultivars such as Magnolia grandiflora. Remove any decaying leaves to avoid risk of rot.

#### SEEDS

Before sowing seeds (see p.55) fresh, clean them (see right). If you cannot thoroughly clean them, use a lungicide to prevent rot or damping off. If only a few germinate, transplant the seedlings in midsummer and return the pot to a cold frame for a second winter.

#### SOFTWOOD CUITINGS FROM A STOCK PLANT



A stock plant
there Magnoba
Spectrue (), kept
under cover in
the regions
stands for
early softwood
cuttings. Take 4m
(10cm) long
cuttings, cutting
stand cover a node



Alternatively, stratify the seeds for 3-6 months at 41°F (5°C), then sow under cover in spring, with 68°F (20°C) bottom heat, to germinate evenly in 5-6 weeks. Seed-raised hybrids flower in 3-10 years, but species may take much longer (up to 30 years for M campbellit)

#### GRAFTING

Chip-bud (see p 60) deciduous magnolias that are difficult to root (for example M. campbellii, M. macrophylla, and large trees). Rootstocks and scions are usually compatible, but match growth habits as

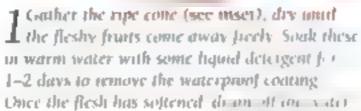
closely as possible. Keep the plants frostfree until spring, then pot them before they start into growth and plant out when 15 months old. Use two-year-old pot-grown seedlings of M. campbellit var mollicomata as stocks for M. campbellit and cultivars and keep in cool shade. Whip or spliced side grafting (see p.58) may be used if budding fails.

#### LAYERING

Simple layer (see p 64) deciduous trees any time between late autumn or early spring and evergreens in early spring

#### **EXTRACTING MAGNOLIA SLEDS**







2 Receive on these than he the sends or he sends are to receive a sends fresh and resource in a cold frame or max with most peat, vermiculate or sand, place in a plastic hag and refrigerate for two months before sown g

#### OTHER GARDEN TREES

NA OPANAX Sow seeds as for Dayidra, see p 79) \$1 KNICHT A Sow seeds as for Grevillea robusta (see p 80) \$1 KOELRECTERIA Take root cuttings as for Acacia (see p.74) \$11. Sow seeds as for Havema (p.81) \$1. Apical-wedge graft as for Laburniam (see facing page) \$11. LAGURSTROPMIA Take softwood cuttings as for Stewartia (see p.90) \$11. Seeds are plentiful, sow as for Stewartia \$1. LAGUNARIA Sow seeds in spring (see p.54) at 77°F (25°C) hairs

Catalogue as for Metrosoleros (see p.84) 1. Sow seeds as for Catalogue robusta (p.80) 1. Latar s Take semi-ripe cuttings. Sow seeds and laver as for flex (see p.81) 1. Latar s Take semi-ripe cuttings. Sow seeds and laver as for flex (see p.81) 1. Libox edges Take semi-ripe cuttings (see p.80) 11. Libox edges (p.72) in summer 1. Sow seeds (p.72) in spring 1. Lindera Semi-ripe cuttings (see p.51) in late summer 11. Seeds as

for Day Jia (p 79) female and male trees needed for fruits [1]
LITCHL Hardwood cuttings (see p 50) from two-year-old wood at late summer to early autumn [1]
Air layer in late winner (p 64) [1]
LIFE ARPUS Sow acoms as for Quercus (see p 88) [1. Spliced sideveneer graft onto pot grown stocks (p 58), use freely seeding species as understocks for any that are shy to fruit [1]
LIMATIA Take softwood cuttings (see p.52) in late spring and semi-ripe cuttings (p.51) in late

Dry fetots

Summer J. Sow seeds as for Grevillea robusta (p.80) J.

LOPHOMYRIUS Semi-ripe cuttings as for Metrosidems (see p.84) J.

Sow seeds as for Sorbus (p.90) J.

LOPHOSTEMON Take semi-ripe cuttings and sow seeds as for Metrosidems (see p.84) J.

MACKIA Take root cuttings as for Acadia (see p.74) J.J. Sow seeds as for Acadia J.

MACADAMIA Soak seeds in Warm water as soon as ripe for 12–24 hours, sow sing y in containers (see p.55) at 70°F (21°C) J.

# MALUS APPLE, CRABAPPLE



Medias I stan Downie SEEDS in late autumn or late wanter []
GRAFTING in late winter []
BUDDING in mid to late summer []

Most ornamental crabapples in this genus are self-stertle, but Malus baccata, M. florentina,

M hapehensis, M sikkimensis, and M toringoides come true to type. Clean the ripe fruits (see p.53) in autumn and sow outdoors (see p.55). Alternatively, store the seeds in a refrigerator (see p.53), in early winter, soak the seeds for 48 hours, drain, and refrigerate for 3–6 months before sowing.

Most ornamental and fruiting trees are grafted. Suitable seed-raised rootstocks (see chart below) may be available from speciality nurseries, plant them out in a nursery bed in the winter before chip-budding (see p 60). It is usual to bud near soil level, but a few pendulous forms may be budded onto a 5–6ft (1 5–2m) stem. Alternatively whip-and-tongue graft scions (see p 59) onto a rootstock obtained by stooling or trench layering (see pp 56–7).

#### APPLE ROOTSTOCKS

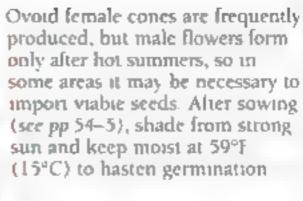
Most cultivars may be grafted onto any of the stocks listed below, choose a stock to determine the size of the grafted tree and according to availability. Dwarfing stocks are best for garden fruit trees. Use MM111 and M25 for large ornamental trees

and was for large orn	or large ornamental frees	
NAME OF ROOTSTOCK	HEIGHT AND SPREAD OF GRAFIED TREE	
M27 Very dwarfing	46ft (1 2-2m)	
M9 Dwarfing	6-10ft (2-3m)	
M26 Semi-dwarfing	8-12ft (2.4-3 6m)	
MM106 Semi- dwarling, resisis woolly aphid	12-18ft (3 6-5 5m	
MM111 Semi- vigorous, resists woo ly aphid	15-20ft (4 5-6m	
M25 Vigorous	20-25ft (6-7 fm)	
Mark Dwarfing, very hardy	6–10ft (2–3m	
Budagovski 9 (Bud 9) Dwarfing, very bardy	6-10ft (2-3m)	
Northern Spy' Seint-dwarfing, resists woolly aphid	12-15ft (3-6-5m)	
MM104 Vigorous, drought resistant in dry greas	15–25ft (5–8m)	
Ottawa 3 Vigorous,	8-10ft (2.4-3m)	

# METASEQUOIA DAWN REDWOOD

SOFTWOOD CUTTINGS in summer ##
HARDWOOD CUTTINGS in late winter ##
SEEDS in spring #

This tree, Metasequoia glyptostroboides, is a living fossil. Softwood cuttings (see p.52) root well if taken from persistent shoots, which shed only their leaves, cuttings from deciduous shoots without buds (which are shed entire) may root but inevitably die. Unusually for conifers, hardwood cuttings may be successful, although slow (see right and p.51). Bottom heat of 64–68°F (18–20°C) ensures rooting in 10–12 weeks, without heat useful numbers should root, albeit after several months. If raising cuttings in a cold frame, pot them on in autumn



#### HARDWOOD CUTTING

Tabe 5m (13cm) cuttings from the current season's growth when it is dormant. Do not recover any buds, tears in the park may adout disease. Store in said antillate winter rieat with hormone rooting compound and insert in equal parts peal and fine back to a depth of 2m (5cm).

# **METROSIDEROS**

COTINGS in late summer to midastumin \$
SECOS in late winter to early spring \$

Some of the trees in this genus are known as pohutakawas. Root semi-ripe cuttings (see p.51) in a closed case with bottom heat of 64–70°F (18–21°C). Store seeds dry over winter, then surface-sow in pots (see p.54) to germinate at 55–59°F (13–15°C). Seedlings and cuttings may be planted out or potted after 2–3 years.

# MORUS MULBERRY



ri-grad

BUDOING in late summer ##

Trees in this genus are sometimes grown for their fruit. Take standard hardwood cuttings (see p 50), or thick pieces of two- to four-year-old wood (truncheons), and

root them outdoors. Chip- or T-bud (see pp 60–2) scions of fruit trees onto two-year-old seedling rootstocks

# NOTHOFAGUS SOUTHERN BEECH

CUTTINGS in early to mid-autumn [].
SEEOS in autumn or in mid- to late winter [...

Trees in this genus are usually grown from seeds (see pp 54–5), although garden seedlings may be hybrids. Sow seeds from the nutake fruits fresh or store dry over winter at 37–41°F (3–5°C) Seedlings may not be ready to plant out for four years. Take semi-ripe cuttings of evergreens such as Nothologus betuloides and N dombeyt (see p.51). Root in rockwool or peat and sand in humidity, with bottom heat of 64–70°F (18–21°C) Plant in three years.

# NYSSA TUPELO, BLACK GUM

SEEDS in late automn or in late winter 1
GRAFTING in late winter 11
LAVERING in late automn or in early spring 1

Tupelos are traditionally raised from seeds. Gather the blue fruits before the birds eat them, clean off the flesh, and sow outdoors (see p 55). Alternatively, stratify for six months at 41°F (5°C) (see p 53), then, eight weeks before sowing soak in water for 48 hours, drain, and refrigerate again. Germination occurs with a minimum nighttime temperature of 50°F (10°C)

Selected forms can be spliced side or whip grafted (see p 58) onto a two- or three-year-old seed-raised rootstock. Layer a mature plant with suitable shoots as for Tilia (see p 91). Saplings may be planted out after 3-4 years.

# OSTRYA HOP HORNBEAM



1,6000

SEEDS in mid to the actions of in late winter I

GRAFTING in take winter or in early spring II

The small female catkins of these trees develop into hoplike clusters of fruits. Seeds do not germinate

reliably, but the yield can be improved by stratifying the seeds (see p 54). Sow fresh, slightly green, cleaned seeds outdoors (see p 55). Alternatively, soak for 48 hours, drain, refrigerate for four months, sow in pots, covered with sin (3mm) of grit, and germinate with a nighttime minimum of 50°F (10°C). Keep for at least a year to allow as many seedlings as possible to germinate.

"Nurse" graft Ostrya onto two- or three-year-old Carpinus betulus seedlings, as for Parrotia (see facing page), for a good-sized tree in 5-6 years.

Canadian series

# PARROTIA

SEEDS in autumn or late winter [ ]
GRAFTING in late winter [ ] [ ]
LAYERING in early summer or midautumn [ ]

Parrotta persica is most often taised from seeds. Sow fresh seeds outdoors in autumn, or soak for 48 hours, drain, and chill for ten weeks before sowing (see p 54). Germination and growth rates tend to be variable, a second flush of seedlings may appear in the second spring. Ironwoods can be layered, as for lindens (see Tiba, p 91).

Cultivar scions can be spliced side or whip grafted (see p 58) onto two- or three-year-old seedlings of Hamanielis virginiana or H. vernalis. To overcome incompatibility, graft low on the stock When potting the grafted plant, cover the graft union with soil mix to promote rooting of the scion. This is a "nurse graft"; cut away the stock when the scion has large enough roots of its own Saplings attain a good size in five years

#### OTHER GARDEN TREE'S

MANGETRA. Take semi-ripe cuttings (see p.51) in late summer with bottom heat of 70°F (21°C) ‡. Remove mango flesh and tough outer seed coar sow large seeds (p.55) (resh at 68–77°F (2c. ...) c. ‡‡ MANC 11-TA. Sow seeds and layer is c.r. Magnoba (see p.83) ‡. Chip-bud as for Magnoba ‡‡.

MELALFULA Semi-rope cuttings and seeds as for Metrosideros (see facing page) 4 M. Licytus (syn. Hymenanthera). Softwood cultings as for Stewartia (see p. 90) 44. Sow seeds as for Dracaena (p. 79) 4

Metiossia Take root cuttings as for Acacia (see p.74) 111. Sow seeds of evergreens as tor Dracagna (p.79) and deciduous species as for Sorbus (p.90) 1.

Mispillus Chip- of T bud (see pp 60–62) or whip-and-tongue graft (p 59) mediar scion onto Cydonia of Crataegus stocks 1 Michelia. Take semi-ripe cuttings (see p 51) 11. Sow seeds as for Magnalia (p 83) 1 Olea. Take semi-ripe cuttings in summer (see p.51) 12. Crack the hard seed coats sow in spring (p 54) to germinate in 4–5

PANDANUS Take cultings as for *Dracaena* (see p. 79) ‡. Clean flesh off seeds, soak for 24 hours, sow singly (p. 55) at 70°F (21°C) in spring ‡. Divide suckers in spring as for Yucca (p. 145) ‡.

months 11

PAULOWNIA Take root cuttings as Acadia (see p. 74, 11. P spiralis may form roots on upper stems, remove entire shoot in spring and plant 1. Seeds as for Stewartta (p. 90) 1. PETOPHORI M. Sow seeds as for Acadia (see p. 74), but at 70°F (2)°C) 1.

PHELLODENDRON Root cuttings as for Acacta (see p. 74) []. Seeds as for Sorbus (p. 90) [.

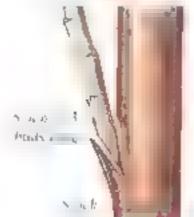
# PERSEA AVOCADO

SEEOS when ope or in spring | GRAFFING in early spring | | |

Persea americana is usually raised from seeds (see below) because it comes virtually true to type. Soak seeds to avoid avocado root rot. Germination occurs at 68–77°F (20–25°C). Grow on the seedlings until they are 12–16in (30–40cm) tall before planting out.

Graft cultivars, for disease resistance and rehable fruiting, onto one- or two-year-old seedling rootstocks of Mexican species, using an apical wedge graft (see p 58) or a side-wedge or saddle graft (see right). The saddle graft unites large areas of cambium, resulting in a strong union, but it requires skill to match the cuts

#### GRAFTING AN AVOCADO





Scient 3-4 bads long

Stock

SIDE WEDGE GRAFT

SADDLE GRALT

To side-wedge graft, make two angled citis, one slightly longer than the other; at the base of the scan, and one downward cut into the rootstock he sacrate graft, cut deep into the scan wood on oversides twisting sharply into the center. Cut the stock to match

#### **GROWING AVOCADOS FROM SEEDS**



I hot water at 100-130% (40-52%) for 30 minutes. Term about in (1em) off the pointed end with a clean sharp kinge. Dip the wound in fungicide

M SEEDS

2 for each sear notice to me por of new section to the cut top of the seed hes just above the next orface (above) it should ground to a bout tour weeks. The

# PICEA SPRUCE



COTTINGS in mickummer or late winter [1].
SEEDS in spring 1.
GRAFTING in late summer or late winter [1].

Cuttings of these conifers are best taken from young plants or dwarf forms. Sow seeds,

if available Picea breweriana is very slow from seeds and is best grafted, as are cultivars of trees

#### CUTTINGS

инотиментовы

Take cuttings from trees that are less than 5–6 years old if possible. Choose nearly ripe shoots (see p.70), they should be firm but not woody at the base if taking cuttings in midwinter, provide bottom heat of 59–68°F (15–20°C) to aid rooting. The cuttings should root, and the buds break, by early summer

#### SEEDS

Gather pendent female cones, which ripen in a season from green or red to purple or brown in autumn, male cones are yellow to reddish purple and are pendent in spring. Extract the seeds (see

p.72) and store in a refrigerator until spring, then sow in containers or in a seedbed (see pp.53-4). Transplant slow-growing seedlings in the second spring, those of vigorous species, for example P abies and P sitchensis, may be transplanted when 2in (5cm) tall

#### GRAFTING

Select vigorous shoots with at least three side buds at the tip as scions to obtain a well-formed tree. One-year-old shoots are best, but two-year-old shoots may be used. Pot the rootstocks (usually two-year-old seedlings of P abies) in winter so they may establish before summer grafting. Keep on the dry side to prevent the sap rising and pinch out the current season's growth just prior to grafting.

Use a spliced side-veneer graft (see p.73) and plunge the plant into moist peat with bottom heat of 70–73°F (21–23°C) until the graft calluses. For winter grafting, use a plastic film tent with bottom heat of 59–64°F (15–18°C) Failed rootstocks from summer grafting can be recycled for winter grafting. If the base of the scion roots, this results in a more robust, own-root plant

# PINUS PINE

SEEDS in spring I GRAFTING in late winter or early spring I

Pines form the largest genus of conifers Species are raised from seeds; cultivars are grafted

#### SPEDS

Cones ripen over two years (three years in Pinus pinea) to brown, either in late winter to spring, such as those of Pinus sylvestris, or in autumn. Extract the seeds (see p. 72), some cones, such as those of P radiata (syn. P insignis) open in the wild only after a forest fire, flame them for a few minutes, allow them to cool, and moisten, then dry them

Refrigerate seeds (see p.72) for three to seven weeks to improve germination how into containers (see p.54) and provide bottom heat of about 59°F (15°C). Protect seedlings from frost and slugs, and transplant when they are 2 in (5cm) tall and woody at the base. They have juvenile leaves for the first 2–3 years.

#### GRAFTING

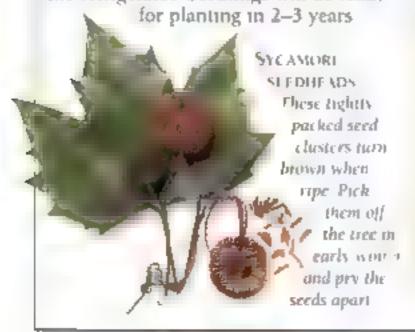
Pot two-year-old seedling rootstocks in spring Bring under cover in late winter Spliced side-veneer graft (see p 73) and plunge in moist peat with bottom heat of 64°F (18°C) to callus in six weeks

# PLATANUS SYCAMORE, PLANE

COTINGS to be autumn!
Seeds in a castamp of in late wine. I

The London plane (Platanus x hispanica syn P x acerifolia) is actually a complex group of hybrids. The best forms are increased by hardwood cuttings (see p 50). Take material from vigorous shoots of the current season's wood, directly after leaf fall. Rooted cuttings can be planted out after 12 months

Seeds produce interesting variations Gather the seeds (see below) in autumn and sow them immediately in a seedhed (see p.55) Alternatively, store the seeds dry in the refrigerator five weeks before sowing in late winter, soak the seeds for 48 hours, allow to drain, and return to the refrigerator. Seedlings will be ready



# POPULUS POPLAR, ASPEN, COTTONWOOD



6" - 116"365 191 Ex2 11- 164 - 1

COTTINGS : land aptions to late winter \$
SEEDS in midsummer \$
GRAFTING in late winter \$\$
SUCKERS in early to late winter \$\$

Hardwood cuttings provide the simplest way of propagating

most of these fast-growing trees, apart from thick-stemmed species such as Populus wilsomi. They are much larger than standard cuttings and so produce a mature plant more quickly. Take the cuttings after leaf fall (see below).

Male and female trees are needed to produce the fluffy seedheads, which have copious amounts of seeds. Spread the down on pots of soil mix (see p 54), cover with Ain (3mm) of very line grit. Keep in a closed case with a nighttime minimum of 50°F (10°C), ideally under mist. Germination should be quite rapid; transplant seedlings as soon as you can handle them. Plant out 18 months later.

Cuttings of some species, such as P szechnanica and P wilsonit, do not root readily. Instead, whip or spliced side graft them (see p.58) onto two-year-old seedling rootstocks of P lasiocarpa

A number of poplars sucker freely for example P afba and P tremula. While the tree is dormant, sever a sucker below its roots and replant or pot to grow on

#### TAKING HARDWOOD CUTTINGS OF POPLAR



Populus x interamericana) up to 6ft (2m) hong from the current season's growth. Cut straight across the union with the main branch



 Remove the 🚄 tip of cacle shoot If it is stile soft ciating back to the ripered hard wood. Trior off any sideshoots The cuttings are best moted when they are to madely Make indeclind pranting hores for the cuttings by driving a wooden. stake or metal tod arto the ground to a depth of about 4t (90cm)



3 the holes and firm of there, the cuttings have been spaced off (2m apart in two stagges of rows. When rooted and into growth in the following years, they will be pruned regularly to form a bedge

#### OTHER GARDEN TREES

PistActa. Take softwood cuttings (see p 52) in midsummer II. Refrigerate moist seeds for two months; sow (p 54) in spring at 50–59°F (10–15°C) I. Chip-bud onto field grown stocks of P atlantica of P terebilihus as for Robinia (p 89) II

P ATYCARIA STROBILACEA. Sow seeds from conclike fruits as for Fagus (see p.80) §. Whip-and-tongue graft as for Fagus §§ PLEMERIA. Take hardwood cuitings (see p.50) when dormant, if white latex is still flowing.

dry cuttings in cool, dark place for few days before inserting in free-draining soil mix at 70°F (21°C) 1. Sow seeds (p 54) as soon as seedpod splits in summer at 70°F (21°C) 1. PODOCARPUS Semi-tipe cuttings (see p.70) in late summer 1. Seeds from single-seeded fruits (pp 54–5) in autumn or spring 11. PSEUDOLARIX AMABILIS (syn. P haempferi). Take greenwood cuttings (see p.52) in early summer 1. Sow seeds (p 55) from ripe, brown, scaly cones in pots in spring 1.

# PRUNUS CHERRY, PEACH, PLUM, APRICOT, ALMOND



Prunus Nac ma rasast

Bodoing and an

Of the many trees in this genus (syn Amygdalus), the orchard trees, such as almonds, apricots, cherries, damsons, peaches, and plums, are best grafted those grown on their own roots tend to be too vigorous and slow to bear fruit Hardwood cuttings are used to propagate some ornamentals, as well as certain rootstocks, evergreen trees may be increased from semi-ripe cuttings. Species may be grown from seeds, but the seedings tend to vary widely

#### CETTINGS

Strong shoots of the ornamentals Primus avium, P cerusifera, and P pseudocerasus form aerial, or adventitious, root buds

These enable hardwood cuttings to root easily, albeit slowly. Take cuttings in autumn and overwinter in bundles (see p.51). Hardwood cuttings can also be taken from stock plants to use as rootstocks such as P cerasifera 'Myrobalan', 'Pixy and 'Colt'. The latter has aerial root buds and roots from large cuttings (see below)

Semi-ripe cuttings of evergreens such as P lusitanica (see p 51) root best with basal heat of 68°F (20°C)

#### SEEDS

Seeds should be gathered, cleaned, and stratified as for Pyrics (see p 88), to ensure a good rate of germination

#### GRAFTING

When grafting Prunus, it is important to use a compatible rootstock (see chart, below). Seed-raised stocks are no longer used, except of the wild cherry, P assum for scions of the Japanese ornamental cherries. Otherwise two-year-old stocks raised from layers (see pp 56–7) or from

uds ow)

GATHERING ALMOND SEEDS

Mounds (Prunus dulcis) are stone fruits not nuts, gather them in autumn as they fall. Peel off the safe highs and child before sowing in spring

cuttings are best. Stocks are generally lined out in open ground to grow on before grafting. Chip- or T-bud (see pp 60-2) or whip-and-tongue graft (see p 59) at ground level on a short stem for weeping trees, you may top-work onto a 5-6tt (1 5-2m) stem of a four- or live-year-old stock (see p 57) for quick results, but the union may be unsightly if the stock is too broad for the scion use an apical-wedge graft (see p 58)

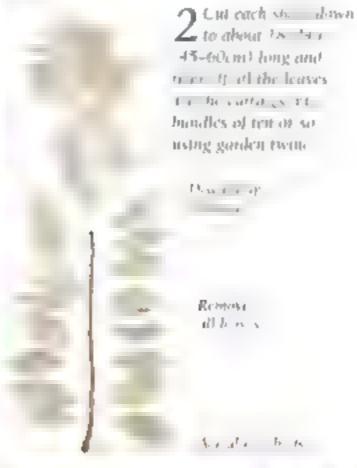
#### RAISING PRUNUS 'COLT' ROOTSTOCKS



I hera'se motstocks he on a Promus Colt stock plant in late authorn take ripe shoots with good mambers of roots breaking at the base of current seasons growth. Cat across each stem



Dig a 14-18m → 40-50cm1 separation shaded narsery bed. Drop in the handers, rooting ends dewn Maca sure that they denot touch. Hate them up so they are about three quarters buried Viernotively, line out the cuttings singly in a slit trench, about 12m (30cm) apart





4 The following spring, lift the buildes and plant the cuttings at 12m (30cm) intervals. The following summer, they will be ready to be used as rootstocks for building (see above)

#### PRUNUS ROOTSTOCKS

Prumus cultivars may be grafted onto the principal rootstocks listed below, choose a stock to determine the size of the grafted tree and according to local availability.

Pickin, Gages, Childre Proms
Pickashera) pamsons, and occlaces
Pixy' Seini-dwarling (Europe
St. Julien A' Semi-vigorous (Europe and
USA)

Brompton' Vigorous (Europe and USA)
Martanna 2624' Semi-Vigorous, resistant
to oak root fungus, root knot neglitodes,
and tomato ring spot virus (Austraka)
Myrobalan' Vigorous (Europe, USA
and Austraka)

PEACHES, NECTARINES, APRICOTS, ALMONDS
St. Julien A' as above
Brompton—as above
Elberta' Vigorous (Austraha) for peaches
and nectarines
'Marianna 2624—as above, for apricots and
sometimes almonds
Nemaguard' Semi-vigorous (Austraha)
for almonds and peaches
'Golden Queen' Vigorous (Austraha), for
almonds, nectarines, and peaches

JAPANESE APRICOT (P MIME)
P cerasifera Vigorous (Europe)

CHERRIES, ORNAMENTAL PRUNCS

Colt' Semi-dwarfing (Europe)

Mazard/ Malling F12/1' Very vigorous,
resists nematodes and canker (Europe
USA, and Australia)

### PSEUDOTSUGA DOUGLAS FIR

SEEDS IN SPRING !

The female cones of these trees have protruding, indent-shaped bracts. Collect them in the first autumn and extract the seeds (see p 72), it is not essential to remove the wings. Store the

seeds in a refrigerator and sow in spring in containers (see p.54), covering them with no more than their own depth of soil mix or fine grit. Bottom heat of 59–64°F (15–18°C) is not needed although it will hasten germination.

# PYRUS PEAR



Pyrus carlersana Chant cices

SEEDS in mid- to late autumn or in late winter 1
GRAFTING in early spring 111
BUDDING in mid- to late summer 11

Grafting is the best way to propagate all of the cultivated fruit trees and most ornamental

pears in this genus. They do not root easily from cuttings and tend to form trees that are too vigorous and slow to fruit if grown on their own roots. Ornamental pears may be raised from seeds, but the seedlings will vary

#### SEEDS

Clean seeds and sow directly (see pp 53–5) or stratify for 90 days at 41°F (5°C). Six weeks before sowing, add enough water to cover the seeds in their bag, chill for 48 hours, drain, and return to the refrigerator. Some of the seeds may have germinated when you come to sow them, if so, surface-sow them and cover with Ain (3mm) of fine-grade vermiculite. Transplant singly as soon as possible, then pot on in the following spring or line out in open ground.

#### ROOTSTOCKS FOR FRUITING PEARS

Use stocks according to local availability and the size of tree required. Quince C. Semi-dwarfing. Quince A. Semi-vigorous.

Quince BA29 Slightly more vigorous than Quince A

Adams 332 Semi-dwarfing, slightly more vigorous than Quince C

OHF 33 (Brokmal) Slightly more vigorous than Quance A, good fireblight resistance P calleryana D6 Vigorous (Australia)

Cuttivars incompatible with Quince Belle Julie', 'Beurré Claugeau', 'Bristol Cross', 'Clapp's Favourite', 'Docteur Jules Guyot', 'Doyenné d'Eté', 'Forelie', Jargonelle', 'Marguérate Manslat', 'Marie-Louise', Merton Pride', 'Packhams Imumph', 'Souvenir du Congrès', and most clones of Withams Bon Chrétien

INTERSTOCKS FOR BOUBLE-WORKING Beurre Hardy', 'Doyenne du Comice', 'Improved Fertility'

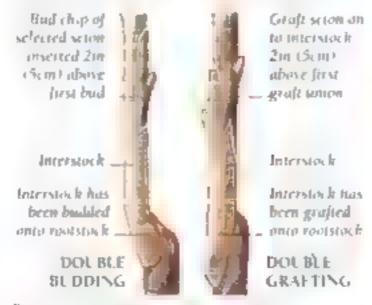
#### GRAFTING

For ornamental pears, chip-bud (see p 60) fairly close to the ground onto two- or three-year-old stocks of Pyrus communis. In some regions, P calleryana is preferred because it is resistant to fireblight and is good for cultivars such as 'Bradford' or Chanticleer', which are not compatible with P communis. A budded plant is usually ready for planting after two years. Graft three evenly spaced buds of the weeping pear, P salicifolia 'Pendula', onto a 5-6ft (1.5-2m) stock for a balanced canopy (see p 57)

If the bud fails to take, use the whipand-tongue graft (see p 59) instead. In early spring, head back the rootstock to remove the failed buds, then graft the scion onto the stock and wax over the cut surfaces to prevent drying out

Graft fruit trees using the whip-andtongue method or chip- or T-budding (see pp 60-2). The principal stocks (see chart, below) for fruit trees are clonal quinces (Cydonia oblonga). They are easier to propagate than clonal stocks of P communis, are more dwarfing, and generally hear better quality fruit earlier

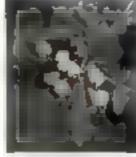
Some fruit cultivars (see chart, below) are not compatible with quince stocks. These need to be "double-worked" using a cultivar that is compatible as an interstock (a "bridging" scion compatible with both the stock and the cultivar to be propagated). If you do not know if a cultivar is compatible with the stock, it is best to double-work it (see below).



#### DOUBLE-WORKING FRUITING PEARS

Chip-bad or whip-and-tongue graft an interstock onto the stock in the first year. The next year, bud or graft a scion onto the interstock on the opposite side. Cut back the interstock to above the second bud once it begins to shoot

# QUERCUS OAK



Quercus maccandiera

CUTTINGS IN early to read autumn 11 SEEDS in mid to late autumn or in early spring 1 GRAFTING in late winter 111

The best way to raise these trees is from seeds, if they are produced. Evergreen

oaks can be increased by cuttings, but only a low percentage root and growth is slow. Evergreens, as well as rare deciduous species and cultivars, may also be grafted

#### CUTTINGS

Insert semi-ripe cuttings (see p 51) in rockwool or equal parts peat and perlite. Root with bottom heat of 64–68°F (18–20°C)

#### SEEDS

Once mature, a large tree can produce thousands of acorns and thus self-sows readily (see below). Gather fresh acorns that have no weevil holes and sow immediately (see pp 53-5), either singly into deep pots or root-trainers or in seedbeds protected from rodents. If rodents are a problem, store moist acorns in the refrigerator and sow in early spring. Transplant seedlings once or twice before planting out (see below)

#### GRAFTING

Oaks fall into botamically related groups such as the red. Turkey, or white oaks Always graft a scion onto a rootstock from the same group to avoid problems with incompatibility. Whip or spliced side graft (see p.58) rare deciduous oaks onto suitable stocks. Spliced side-veneer graft evergreens (see p.58) onto three-or four-year-old pot-grown seedlings. Grafts should unite in 5-6 weeks. Do not head back the stock fully until growth begins in the second year. Plant out grafted oaks 3-4 years later.



SELE-SOWN OAK SEEDLING

in spring, as soon as they have two or three leaves, transplant self-sown seedlings two a nursery bed. Transplant again before planting out to encourage growth of a fibrous root system This enables the sapling to establish more easily

# ROBINIA LOCUST



Robinta Idaho

CUTINGS in late autumn to early winter \$1 SEEDS in late winter \$ BUDDING in early spring \$1 DIVISION in late winter to early spring \$1

Root cuttings are best taken from young trees in this genus. Most

may be grown from seeds. Cultivars of Robinia pseudoacacia must be increased by grafting, the suckering habit of some species can be exploited.

#### CUTTINGS

Take 3-6in (8-15cm) root cuttings as for Atlanthus (see p 75). In cold areas store them vertically in a box of sand in a frost-free place. Then in early spring, insert them zin (1cm) deep in free-draining soil mix to root at 50°F (10°C). Plant when 2-3ft (60-90cm) tall.

#### SEEDS

Break down the impermeable seed coats by abrading them (see p.53), or place in hot water and leave for 48 hours. Sow in pots (see p.54), keep in a sheltered place with a nighttime minimum of 50–59°f (10–15°C) to germinate in three months

#### GRAFTING

Chip- or T-bud R. pseudoacacia cultivars onto two-year-old R. pseudoacacia stocks (see pp 60–2). R. pseudoacacia Umbraculifera' has a dense, umbrellalike cantopy top-work two buds at a height of 5–6ft (1.5–2m) onto three- or four-year-old stocks. An apical-wedge graft (see p.58) is less easy and the graft union is not as next

#### DIVISION

Remove suckers of R pseudoacacia before the tree starts into growth and replant to grow on. The tree will sucker more freely if cut back hard in spring do this to raise R pseudoacacia stocks

# SALIX WILLOW

COTTINGS in late autumn to early spring | SEEDS in late spring to maisummer | GRAFFING from mid- to late winter 12

The many species of tree willows are most easily grown from cuttings but they can be grafted to create an attractive weeping standard. Seeds, if produced on female trees, must be sown fresh

#### CUTTINGS

Hardwood cuttings of vigorous willows may be as long as 6ft (2m) and planted out immediately to mature faster than standard 8in (20cm) cuttings (see p 50). Take cuttings in late autumn from new, fully hardened wood that does not need to be very woody. Line them out in open ground, pot them, or place them in bundles in a frost-free sandbed to root Select those in active growth in spring to pot. Salix fargesit and S. moupmensis do not root very readily in open ground. Cuttings may also be taken of green or semi-ripe wood (see pp 51–2).

#### SEEDS

Seeds must be sown fresh. Collect the seedheads as soon as they are ripe and fluffy. Tease apart the down, sow it (see p.54), and cover with Ain (3mm) of fine grit. Place under mist or in a closed case to germinate in a day or so.



STOCK PLANT OF WILLOW

Willows can be cut down almost to the ground (coppied) each year to produce new long shoots for cuttings. The shoots can also be hilled up to mean up them to root (stooling see p 36).

#### GRAFTING

Whip-and-tongue graft (see p 59) two or three scions of S. caprea 'Kilmarnock or S. caprea var pendula onto hardwood cuttings of S. x smithiana or S. viminalis as shown below. Seal the grafted area with wax to prevent drying out and keep moist and frost-free to callus. Graft a half-standard of S. integra 'Hakuro-nishiki onto 30–36 in (75–90 cm) stems of S. x smithiana or S. caprea.

#### CREATING A STANDARD WEEPING WILLOW



Critical Control of the Control of t

ARDINA



GRALTED PLANT
The coating will
toot and the grafe
rallus and shoot
simultaneouses
within 12 weeks.
Once new growth
begans, feed and
water Rich out any
sideshoots as they
appear on the
stem Plant out
after two years

#### OTHER GARDEN TREES

PTELEA Softwood cuttings (see p 52) in late spring 11. Take root cuttings as for Acacia (p.74) 11. Sow seeds as for Sarbus (p.90) 1. PTEROCARIA Root cuttings as for Acacia (see p.74) 11. Sow seeds as for Fagus (p.80) 1. Simple layer (p.64) in late autumn to spring 1. Remove suckers as for Robinia 1. PTEROCE(TIS TATARINOWIL Sow seeds as for Zeikova (see p.91) 1. RADERMACHERA Take semi-ripe cuttings (see p.51) in summer 11. Sow seeds as soon as ripe (p.54).

at 70°F (21°C) in late summer 1.
RAVLNALA MADAGASCARIENSIS Sow seeds (see p.54) at 70°F (21°C) when ripe, scarify 1. Remove rooted suckers in spring 1.
REHDERG DENDRON Softwood cuttings as Stewartia (see p.90) 11. Seeds as Davidia (p.79) 111. ROTIOMANNIA. Take semi-ripe cuttings (see p.51) in summer 1. Sow seeds as soon as ripe after souking for 24 hours (p.54) 1. SAPINDUS Sepii tipe cuttings (see p.51) from midsummer to early

autumn 41. Remove fleshy seed coats sow at 70°F (21°C) in soil-based mix in spring 4. SAPR M. Sow seeds of temperate and hardy species as Magnoba (see p.83) and of tropical species as for Coccoloba (p.79) 4. Whip graft (p.58) cultivars in late winter 44. SASSAFRAS Take root cuttings as for Acacta (see p.74) 111. Sow seeds as for Sorbus (p.90), but cold moist stratify (p.54) for 3-4 months before sowing 4.

SCREEFLERA (syn Brassam) Take semi-ripe cuttings, leaf bud cuttings and air layer as for Figus (see p.80) §. Extract seeds from fleshy fruits when ripe, sow at once (p.54) at 70°F (21°C) §. Sc. in S. Take semi-ripe cuttings as for Grevillea (see p.80) §§. Sow seeds as for Acacia (p.74) §. Schotia Seeds as Acacia (p.74) §. Schotia Seeds as Acacia (p.74) § Schotia Seeds (p.54) in spring § S

# SEQUOLADENDRON GIANT REDWOOD

Cuttings atom spring to rate automn \$ Secos in spring \$

This single species, Sequotadendron giganteum, is closely related to Sequota, the coast redwood. Best results are likely from 4in (10cm) cuttings taken in late summer from the green shoot tips. Treat as for greenwood cuttings (see p 52), bottom heat of 68°F (20°C) is beneficial.

Extract the seeds (see p 71), store in a refrigerator and sow in containers (see p.54), covering them with only their own depth of soil mix or fine grit. Bottom heat of 59°F (15°C) should hasten germination

The fast-growing seedlings are prone to damping off (see p. 46). Transplant the seedlings when they are 2–3m.

(5–8cm) tall

#### UNRIPE FEMALE CONE

The 3m (8cm) long overal cones take two viaits to take to make a present but remain on the extra term may see as

# SOPHORA

CUTINGS from midsummer to early autumn \$1 SEEDS in midwinter \$1 GRAFTING in late winter \$11 BUDDING in mid- to late summer \$11

There are both trees and shrubs in this genus. Evergreen species such as Sophora microphylla (syn. Edwardsia microphylla) and S. tetraptera may be raised from semi-ripe cuttings (see p.51)

Treat the hard, pealike seeds as for Ropuna (see p 89), plant the seedlings out in the third growing season. The pendulous form of the Japanese pagoda.

tree (S japanica 'Pendula') sets seeds fairly freely, but only in long, hot summers; only a small percentage of seedlings will come true

Whip or spliced side graft (see p 58) cultivars of deciduous species such as 5. japonica onto two- or three-veir old pot-grown seedlings or chip-bud (see p 60) outdoors. S. japonica 'Pendula' can also be top-worked onto four- or five-year-old seedlings, spliced side-veneer graft (see p 58) two scions or chip-bud two buds at 5–6ft (1 5–2in) on the stem

# STEWARTIA



Stewartia monaderpha

SEEDS in late autumn or it late winter 1

There are deciduous and evergreen trees in this genus (syn Stuartia)
Root softwood cultings (see p.52) with bottom heat of 65–70°F

(19–21°C). Feed rooted cuttings well so they make enough root growth to grow well in spring Seeds are not easy to obtain from trees or suppliers. They need chilling (see p.54) and a nighttime minimum of 50°F (10°C). If they do not germinate in three months, leave outdoors for a year. Plant out seedings in the third year.

# TAXUS YEW

CUTTINGS in autumn \$1 GRAFTING in late summer or late winter \$1 SEEOS at any time of year \$11

Female trees in this genus do not have cones but single-seeded fruits in fleshy red cups, or arils. Raising yews from seeds is a slow process. Cuttings are quicker but must be taken from suitable shoots. Some cultivars are reluctant to root so therefore must be grafted.

#### CUTTINGS

Take 4-6in (10-15cm) cuttings (see p 70) from one- to three-year-old shoots that are strongly upright and nearly ripe, but green at the base. Hormone rooting compound helps. Cuttings root by early summer outdoors, and earlier under mist with bottom heat of 68°F (20°C).

#### SEEDS

The arils turn red as the seeds ripen in autumn. The hard seed coats are usually broken down in the gut of a bird or mammal and germinate after a period of cold. Speed germination by mixing the seeds with damp peat or sand (see p 53) and keeping them at about 68°F (20°C), for example in a warm closet, for 4-5 months, then chilling them for three months at around 34°F (1°C) However seeds that germinate in late summer will have too little time to put on growth before winter. It may be more practical to store the seeds, sow them in spring in pots (see p.54), and keep them outdoors for 1-2 years until they germinate

#### GRAFTING

In spring, pot pencil thick three-year-old seedlings, grow on until late summer Spliced side-vencer graft onto these rootstocks, as for Picca (see p.85). Extra heat is not needed, but shading may be The union should callus in six weeks.

# SORBUS MOUNTAIN ASH



Sorbus

SEEDS in early automore to lace winter I
GRAFTING is rate winter to early spring III

early spring 111 BUDDING in mid-to late summer 11

Not all the trees in this genus come true from seeds, but many

Including Sarbus cashmiriana,
S. hapehensis (syn. S. glabrescens), and
S. forrestit, are apomictic, that is, viable seeds develop without being fertilized and produce seedlings identical to the parent. Mountain ashes may also be grafted, but care must be taken to use compatible rootstocks

#### SEEDS

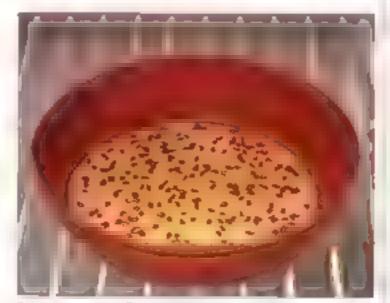
Sow seeds from bernes gathered just after ripening in the autumn before germination inhibitors develop. Otherwise, cold stratify the seeds for two months at 41°F (5°C), or as shown right, before sowing. The seeds usually germinate readily, transplant singly in late spring, plant in the next autumn

#### GRAFTING

Botanically, Sorbus is divided into three groups: Aria (whitebeams), Aucuparia (mountain ashes) and Micromeles. The Aucuparia cultivars can be chip-budded

(see p 60) onto S. aucuparia, and Aria onto S. aria or sometimes S. lanfolia, Budded plants may be planted out in 15 months

Trees in the Micromeles group (such as S. folgneri and S. megalocarpa) are spliced side of whip grafted (see p.58), as are rare species such as S. harrowiana S. alnifolia is used as a rootstock for S. megalocarpa and S. aucuparia as a stock for S. harrowiana. If the graft unions are waxed, keep the plants at 50°F (10°C). If unwaxed, they may be placed in a high-humidity tent.



STRATUFVING SORBL'S SEEDS

Place the seeds on moist blotting paper in a saucer, then refrigerate for two months before sowing. Check regularly and remoisten the paper it necessary. If the seeds start to germinate sow them immediately

# TILIA LINDEN

SEEOS in mid- to late autumn or mid- to late winter \{\bar{\pi}\}

BUDDING in mid- to late summer \{\bar{\pi}\}

LAYERING in late datasen or only spring \{\bar{\pi}\}

Seeds of these trees are not always available or easy to germinate but may be used to raise rare species. Chip-budding is the accepted method of propagating many lindens but care must be taken to use a compatible rootstock. The European linden (Tha x europaea) may also be layered

#### SEEDS

Linden seeds have dormant embryos and impermeable seed coats, so they germinate erratically. Gather seeds when just ripe, before germination inhibitors develop, or soak in warm water for 48 hours, drain, store until midwinter, sow (see p 54) and keep at about 50°F (10°C). If they do not germinate in three months, give the seeds a second period of cold.

#### BUDDING

T americana, T cordata, T x euchlora, and more extensively, T platyphyllos are used as rootstocks for chip-budding (see p 60) Grafts should take in 4-6 weeks

#### LAYERING

If large numbers of plants are needed stool a young tree (see p 56) to obtain plenty of strong, new shoots in alternate years. In the following year, simple layer each shoot (see p 64) after preparing the ground with a mixture of peat and sand Remove rooted shoots in the following autumn at leaf fall or in the following spring. Head back the stooled plant to one or two buds to repeat the process.

If only one or two plants are needed, simple layer a low branch. The point of contact with the soil, and of wounding may be on second- or third-year wood. If the wound is on older wood, it may not root in the first season, tease away the soil in autumn to inspect the new roots and if needed leave for a year.



LINDEN FRUITS

Gather the mutlike fruits—here of Tisia oliveri) before they fall. Remove the outer husks. Sow the seeds connectionally outdoors in cold climates, or chilt before sowing (see pp 54–5)

# ULMUS FLM

Cuttings in midsummer 11
SEEDS in an arrow of read it and winter 1
BUDDING in mid- to late stammer 11

Seeds from species of these trees, such as *U americana*, *U glabra*, *U parvifolia*, and *U pumila* germinate well *U. americana*, *U x hollandica*, and *U parvifolia* may be propagated from cuttings. Chip-bud *U x hollandica* 'Jacqueline Hillier' and cultivars of *U glabra*, such as 'Lutescens' and 'Crispa'

#### CUTTINGS

Rooted soft- or greenwood cuttings (see p.52) need to make good growth to survive the winter. Keep frost-free and pot before growth commences in spring.

#### SEEDS

As soon as they ripen in mid- to late autumn, sow the winged seeds thinly in seed trays (see p 54) and overwinter outdoors. Alternatively, store the seeds dry at 37°F (3°C) and sow in late winter

#### BUDDING

Chip-bud cultivars (see p 60) onto twoor three-year-old U glabra seedlings that have been grown on in a nursery bed U glabra 'Camperdownii' is usually topworked to create a standard chip-bud three buds at a height of 5-6ft (1 5-2m) onto five- or six-year-old stocks that have been trained into a straight stem The buds should take in 4-6 weeks

# ZELKOVA

SEEDS a mid to late territor !
GRAFTING TO LEE WORLT OF TO A RES, TOE !!!

The seeds of these trees need a period of cold before sowing (see p.54) and a nighttime minimum of 50°F (10°C) to germinate within 8–10 weeks. Protect the seedlings from frost and transplant in midsummer or early in the next spring. Grow on for three years

Whip or spliced side graft (see p 58) cultivars such as Zelkova serrata Village Green' or Z. x verschaffeltn onto two- or

three-year-old pot-grown seedlings of Zelhova, Ulmus parviflora, or U. pumila Keep the stocks watered sparingly at 50–55°F (10–12°C) for a few weeks before grafting. Prepare 4–6in (10–15cm) scions from vigorous, new or two-year-old wood, and seal each graft with wax to prevent drying out. Keep the plants on the open bench with an air temperature of 50°F (10°C) and bottom heat of 65°F (18°C) and regularly mist-spray. Grafts should take in six weeks

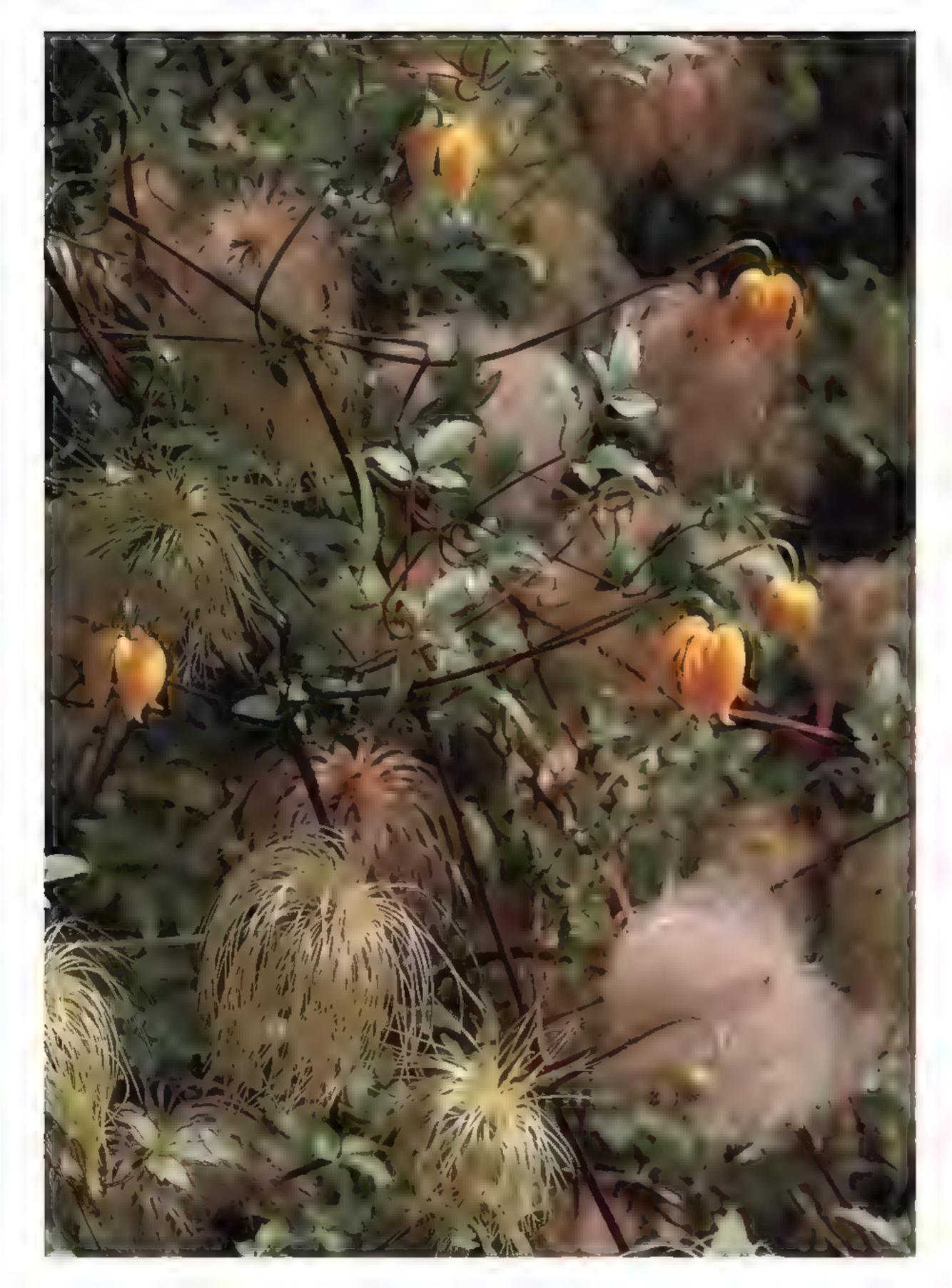
#### **OTHER GARDEN TREES**

SEQUOIA As for Sequentide Indian (see p. 90) 1 SUSBANIA (SVn. Daubentoma) Take greenwood cuttings as for Acada (see p 74) 444 Sow seeds as for Acacia 4 SPATHODTA CAMPANULATA, Seint ripe cuttings: as Magnolia (see p 8.1) L. Remove seeds from outer coating, sow singly (p.54) in freedraining soil mix at 70°F (21°C) in spring 1 STENOCARPUS Semi-ripe cuttings as for flex (see p.81) []. Sow fresh seeds (p.54) in spring or summer at 59-68°F (15-20°C) [ STYRAX Take softwood cuttings as for Stewartia (see p 90) 11. Seeds are thought to be doubly dormant, but low yields may be gained by sowing seeds as for Stewartia L 5vzvGitM Take semi-ripe cuttings (see p 51) in summer \$. Sow seeds (p.54) from fleshy. fruits when ripe at 70°F (21°C) 1 TABEBUIA Take semi-rape cuttings (see p 51) of evergreens in late spring and softwood cuttings of deciduous species as for Acer (p.74) 11. Sow seeds as soon as ripe (p.54) at 70°F (21°C) L

Testatishes Take greenwood cuttings as for Acacia (see p.74) 111. Sow seeds as Acacia 1. Taxonii M. Take hardwood cuttings (see p.50) in late winter or softwood cuttings (p.52) in summer from persistent shoots with buds, root under mist with bottom.

SYZYGR M AROMATICEM

heat of 64-68' I
(18-20°C) 1. Sow
seeds (p 5.3) from
single brown cones
in spring 1
Tecoma. Take greenwood and
root cuttings as for Catalpa (see p.77) 11
Sow seeds as for Catalpa 1
Terminatia. Sow seeds as for Spathodea 1.
Thevetia. Take semi-ripe cuttings (see p.51)
of cultivars in mid- to late summer 1. Sow
seeds as for Syzygium 1.





# SHRUBS AND CLIMBING PLANTS

Shrubs and woody climbers form the backbone of any garden planting but vary enormously in habit, form, and productive lifespan; they can be propagated by an equally wide range of techniques

Shrubs and climbing plants represent an invaluable and long-lasting source of shape, texture, and color in the garden. They encompass a wide spectrum of sizes and habits, from fast-growing climbers (that provide almost instant cover for unsightly buildings or walls) and ground-cover plants to slow-maturing woody shrubs that will grace a border over a period of many years

A shrub is a deciduous or evergreen perennial with multiple woody stems or branches, generally originating from or near its base. Subshrubs are woody-based plants with soft-wooded stems. Climbers are plants that climb or cling by means of modified stems, roots, leaves, or leaf stalks, using other plants or objects as support. Woody-stemmed climbers are covered here.

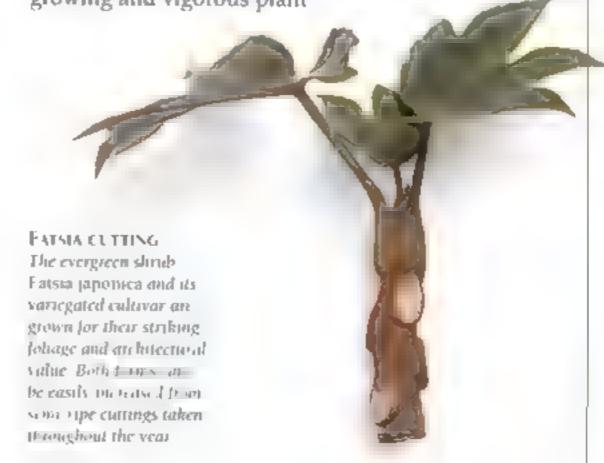
The rooting of cuttings, in their many variations, is by far the most widely used method of propagating shrubs and climbers, especially when a large number of new plants is required Many may also be raised in numbers from seeds, although, as with other plants, only species will come true to type

CLEMATIS 'BILL MACKENZIF'
Our particular clematis is prized for its

verlow lantern shaped flowers and its silvery seedheads. It is thought to be a hybrid of Clematis tangutica and Correntalis, of which there are many forms in cultivation

The natural propensity of some shrubs and climbers to produce suckers or rooted layers can be exploited as an easy and reliable method of propagation where only a few new plants are needed, especially for shrubs that are difficult to propagate by other means, such as some camellias, magnolias, and rhododendrons. Heaths and heathers respond particularly well to layering.

Cultivars that are difficult to propagate (or that require a rootstock to control growth and flowering, as in the case of roses), are best grafted or budded. This requires a little more care but, if successful, rewards the gardener with a fast-growing and vigorous plant



# TAKING CUTTINGS

Raising new plants from cuttings is frequently a very straightforward process, and it is the most popular technique for propagating the majority of shrubs and climbers. Choosing the type of cutting and the ripeness of the wood best suited to a particular plant is very important to the success of the process (see pp 118–45 for information on individual plants)

It is important to select cutting material very carefully, avoiding any shoots where pests or diseases may be present and discarding any damaged material, since this will be vulnerable to fungal attack. Use typical, horizontal shoots, with nodes that are normally spaced, rather than atypical, very upright, stretched-out shoots. Never propagate from a variegated plant that is showing signs of reverting to its all-green form

Some plants produce juvenile foliage, which turns into adult foliage after a number of years. This often coincides with a slowing down of the annual rate of growth of the plant, as it turns its attention to flowering. An example of this is the English tvy (Hedera helix) Unless you specifically require the adult foliage form of a plant, always remember



This Pyracantha shoot shows the different stages of woodness. The softwood at the up is still green, soft and suppy, while the greenwood in the middle is less flexable. The base of the shoot is senti-ripe, becoming woods and dark

#### TRIMMING A CUTTING



Cuttings are usually trimmed just below a node where the growth harmones accumulate (see left). Easily rooted plants can be cut between the mades (see right), to create more cuttings quickly

#### TYPES OF CUTTING

Taking cuttings is one of the easiest ways of propagating many shrubs and climbers, with a will war as it is propagating many shall all be used.

If exical be eaterful from a like prince (softwood) to winter thanks of



to take cuttings from stems that have juvenile foliage, because these will root much more readily

Cuttings root most easily when the parent plant is young and producing good lengths of new growth each year Juvenility can often be restored to a plant by pruning back hard into old wood. The best material is usually the new growth that is neither very thin and weak, nor very vigorous, the latter is often hollow and prone to rot. Choose instead the material in between these two extremes, which has the normal pattern of internodal growth between two leaves or two sets of leaves.

Most cuttings will be from wood of the current season's growth. Some shrubs, such as deciduous azaleas and magnolias, root best if the material is forced under protection early in the year. In some regions, by the time growth occurs in the garden it may be too late to root cuttings with confidence. Alternatively, use plants bought from the local garden center, which invariably will have been grown under protection, as stock plants (see p.24).

#### NODAL AND INTERNODAL CUTTINGS

With most shrubs and climbers, "nodal" cuttings, trimmed just below a node (see left), root well. Some plants, however, also root very readily when the base of the cutting is made some way below the node. Such a cutting is described as "internodal," because the cut is made at a point between the nodes rather than just below them.

People often think that one stem yields only a single cutting from the stem up. On the contrary, several nodal cuttings or many more internodal cuttings can be obtained from one length (see right) of stem. This applies to greenwood, semi-ripe, and hardwood cuttings. Make sure that the stem.



then they will root at a similar speed which aids handling later on

#### PREPARING CUTTINGS

Collect material early in the day, when the plant is fully turgid, before the sun diminishes the plants vital water reserves that have been built up overnight. Store fresh cuttings in a clean plastic bag and label them correctly. Note both the name and details of propagation. You can either prepare the cuttings immediately or store them in a cool place, out of direct sunlight, for a couple of hours at most. If you are unable to continue on the same day, place the plastic bags containing the material in a refrigerator, where the cuttings will

#### STEM CUTTINGS



One stem-tip and several stem trings can be taken from one stem, mereasing the yield of cuttings from fewer shoots.

Keep the cuttings the same six

HARDWOOD Detres at

remain fresh and in good condition for a number of days. When preparing cuttings, keep tools, equipment, and surfaces sterile (see p.30)

Almost all cuttings respond to attificial rooting hormones, available as powders. liquids, and gels (see p. 29) On difficult subjects, they can mean the a flerence between success and failure

Wounding a cutting, by removing a sliver of bark at the base of its stem exposes the area where most celt division takes place and so increases the uptake of water and rooting hormone On some shrubs, such as rhododendrons, wounding is essential, otherwise, roots often fail to break through the tough outer layers of coils. Take care not to create too deep a wound and expose the pith, however, since this may lead to rot and failure

#### ROOTING CUTTINGS

For shrub and climbers, a good rooting medium is one of equal parts peat and bark with a particle size of /-/nn (3-12mm), or peat and perlite. For a free-draining medium, use equal paris of peat, medium-grade perlite, and bark Rockwool (or florists foam) is a good alternative; with easily rooted material watering is easier, whereas cuttings that are difficult to root have a better rate of success, provided that the medium is kept moist but not wet. (See also pp.32-5 for suitable mores and media)

All cuttings, before being inserted in the rooting medium, benefit from a heavy fungicidal spray, or "sprench a compromise between spraying and drenching. Gray mold or botryus, is the most common disease affecting cuttings use a fungicide every two weeks while

cultings are rooting

After inserting the cuttings, water the medium thoroughly, and then make sure that it does not dry out at any time If ander cover, air the cuttings at least twice a week, for ten minutes at a time removing any dead material or fallen foliage. If in a greenhouse, when it is hot provide additional shading and damp down at least three times a day Keep containers out of direct sunlight

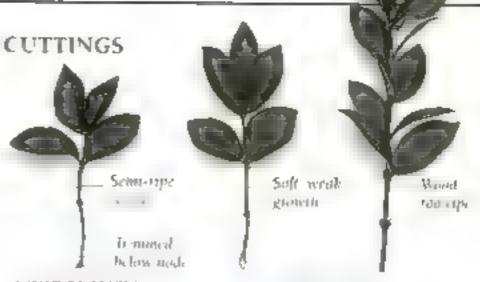
Slow-release fertilizer improves the vigor of a rooted cutting, add a teaspoon to each quart of medium in summer and a half teaspoon in winter Liquid feeding with a baianced fertilizer at the package's recommended rate throughout the entire growing season is an equally beneficial alternative to slow-release fertilizer

#### SEM.-RIPE CUTTINGS

This type of cutting involves material of the current season's growth that has begun to firm, the base of the cutting should be quite hard, while the tip of the cutting should (continued on p.96)

# SELECTING SEMI-RIPE CUTTINGS

To take senu-ripe cuttings here from a shrubby noneysuckle Lonicera) select lengths of healthy new wood that has not fully handened (see right) Do not chosse shoots that have become too woodly or those that are still soft and suppy (see far ghr)



GOOD EXAMPLE

BAD LVAMPULS

#### TAKING SEMI-RIPE CUTTINGS



I in mal- to late summer, select a healthy shoot L of the current seasons growth there from a Japanese laurel, Aucuba). Lise clean sharp primers to sever the cutting just above a node



 If not prepared immediately, put the shoot in a clear plastic bag and label. Store in a cool place out of direct surlight for a couple of hours or in a refrigerator for a few days.

se a cican

sharp kone



Remove the sideshoots from the main stem. Drim each sideshoot to 4-6in (10-15cm 1 ng cutting just below a node. Remove the lowest pair of leaves and the soft tip



Make a shallow wound on one side of the Tyers by carefully cutting away a piece of to the -said (1-2cm) long from the base of the stem. This will help stimulate moting



Dip the base of the cutting, including the I entire wound, into some hormone rooting compound (here in powder form). Make sure that the wound has an even, but thin, coating



Insert the cuttings in rooting medium in a nursery bed outdoors (or under mist spacing them 3-4m (8-10cm) apart. Water well. Cover to keep humid until moted

still be actively growing and therefore still soft. The list of shrubs and climbers for which this method is suitable covers a very wide range of plants, including both evergreen and deciduous species. from Cotoneaster and Mahania to some lavenders. Semi-ripe cuttings are good for obtaining large numbers of plants to produce a hedge of boxwood or Pyracantha, for example. Many commercial nurseries keep stock plants of shrubs such as boxwood as hedges because the clippings make ideal and plentiful cuttings.

The best time to take semi-ripe cuttings is from mid- to late summer, or even in early autumn. In warm climates, growth may be semi-ripe in early summer. The length of the cutting is dependent on the growth habit of the plant being propagated, but between 24—4in (6—10cm) is suitable for cuttings of most shrubs and climbers. Choose a healthy-looking stem (see p.95), remove any sideshoots, and trim the cutting. Wound the stem and apply a generous coating of hormone rooting compound shaking off any excess if using powder.

Semi-ripe cuttings may be rooted in a variety of situations. To prepare an outdoor nursery bed, mix some soilless potting mix into the soil to a depth of 6-8in (15-20cm) and insert the cuttings directly into it. Cover the bed to keep the soil mix moist (see below) and shade if necessary to protect the cuttings from being scorched. The cuttings may also be inserted in rooting medium in containers in cells in soil mix, or in rockwool Place the containers in a cold frame a plastic tunnel, or on a heated bench under a plastic tent (see p.44), according to the conditions required (see pp.118-45 for individual plant needs).

Although semi-ripe cuttings are less prone to wilting than softwood cuttings a humid environment is essential so that the rooting process can take place with the minimum of stress. Gray-leaved plants need a slightly drier environment

#### HEEL CUTTINGS



Larefully pull away a healthy sideshoot of the current season's growth chere of a Ceanothas), so that it comes away with a sliver, or "heel," of back from the parent stand. The sideshoot should be about stat(10cm) long.

which will occur if their foliage is constantly damp. Regularly air such cuttings in a plastic tent. They also root well in a frost-free cold frame or similar structure rather than in the more humid atmosphere of a greenhouse.

During winter, inspect the cuttings regularly and remove any fallen leaves. Water if the medium shows any signs of drying out. The cuttings will normally require a further growing season before rooting satisfactorily and should be gradually hardened off (see p.45) during spring and summer before the new plants are potted or planted out.

Direct rooting of cuttings in pots For easily rooted plants with a very high success rate, space out 2–3 semi-ripe cuttings in a 3—tin (8–10cm) pot. This extra space produces cuttings ready to be planted into the garden without the need for any intermediate stage of

# SEFORE ATTIC

2 from off the "tail" of the heef with a crear sharp knote. The heef contains growth hormones that will encourage moning. Depending on the manarry of the stem, follow the technique for greenwood, sent ripe, or hardwood cuttings.

potting, and in some cases advancing planting by an entire growing season incorporate fertilizer into the rooting medium or apply a liquid feed once the cuttings have rooted, because they will be in the same soil mix longer than usual. If specimen plants are required, pot the cuttings singly into larger containers when needed. This technique is demanding on propagation space, so do not attempt it unless the plant is

suited to this method (see pp 118-45)

#### HEEL AND MALLET CUTTINGS

For plants that are difficult to root, it is a good idea to take heel cuttings (see above). The heel forms an area where the natural rooting hormones of the plant build up, creating better chances of success in rooting the cutting. It also provides a hard end-point to the cutting, which is consequently less prone to fungal attack. It is possible to root many Ceanothus species in this way. Some Berberis species and their cultivars root best from mailet cuttings (see p.119)

#### OUTDOOR NURSERY BEDS

If rooting cuttings in any quantity, an outdoor nursery bed provides the best conditions in which to grow on new plants in containers once hardened off There are two types, sand beds and water-permeable fabric beds (see p 40)

Water-permeable fabric suppresses weeds, helps protect plants from soil-borne diseases, and allows containers to drain freely while giving plants access to water through capillary action. Sand beds need less watering than fabric beds, because they provide a water reservoir I veess water drains away, but the soil mix in the pots does not dry out

#### SEMI-RIPE CUTTINGS UNDER COVER

You can root cattings under a large clocke or plastic tunnel.

Prepare an outdoor nursery bed by mixing rooting medium into the soil. Insert the cuttings direct. Keep the medium moist. Shadi, the clocke with netting to protect the cuttings from some grandight.

Netting provides shade

2-3m (5-8cm) apart



#### LEAF-BUO CUTTINGS

This method makes economical use of semi-ripe material from the parent plant, producing many cuttings from one vigorous shoot. A leaf-bud cutting (see right) requires only a short piece of semi-ripe stem to provide food reserves since it also manufactures some food through its leaf or leaves. Leaf-bud cuttings can be internodal, which usually works well with clematis and honeysuckle (Lonicera), or nodal, which is more suitable for plants with hollow stems or ones that are susceptible to rot, such as camelhas

In late summer or early autumn using pruners or a sharp knife, remove a strong shoot (see below), severing it between the nodes to create a number of internodal cuttings, each with 1-2 leaves. You should end up with several from one stem. Alternatively, if more appropriate for the individual plant (see pp 118–45), divide it into nodal cuttings by cutting just below a node at the base of each cutting and just above the node at the top. When preparing leaf-bud cuttings, always take care to retain the growth buds in the leaf axil at the tip

#### LEAF-BUD CUTTINGS

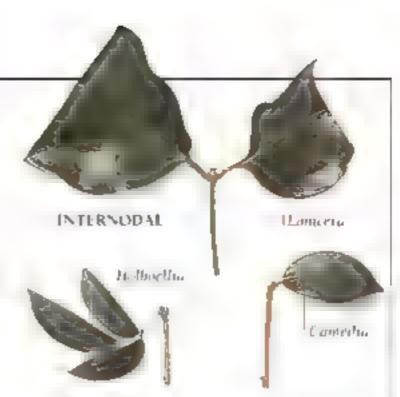
Leaf-bud cuttings are made up of a single leaf or a pair of leaves containing a growth bud and a short piece of stem. They can be either nodal or internodal. Semi-ripe leaf-bud cuttings are taken



INTERNODAL

they are all too easily nipped out by mistake. With some species, the buds are quite long, in this case, the cutting should be cut back to just above the top pair of leaves, so as not to damage the buds. With smaller buds, cut back to just above the top leaves

If the plant from which you are taking cuttings has large leaves, it is a good idea to trim them by cutting across the leaf (see Lonicera cutting, above) Wounding the cutting is not necessary, but may be a good idea for plants that have very woody stems. Apply a good



NODAL

coating of hormone rooting compound to the base of each cutting, shaking off. the excess if using powder. Insert the cuttings into a pot filled with rooting medium. After watering in and labeling keep the cuttings humid by placing them in a closed case or under plastic Some less hardy plants may require bottom heat to aid rooting

INTERNODAL

When the cuttings have rooted usually about eight weeks later, pot the young plants into individual containers in soil mix and grow them on until established

#### TAKING LEAF-BUD CUTTINGS FROM SHRUBS AND CLIMBING PLANTS



Select a healthy shoot of the current seasons I growth (here of tvy, Hedera). Take the length required (you will produce as many cuttings as there are nodes) cutting just above a node. Put in a plastic bag to keep the shoot from drying out



The clean primars or a garden knife to cut Lap the smoot. Car the stem just above every node to create internodal cuttings with one or two leaves (see above). Prepare nodal cuttings by trimming each cutting below a node at the base and above the node at the top



4 Firm and water in the cuttings and label the pots. Place them under cover and keep the environment humid by misting if needed Bottom heat is not required for ivies. The cuttings should take about eight weeks to root



Dip cach prepared cutting (see inset) in Some hormone rooting compound such as gel. Fill a pot with rooting medium and main holes for the cuttings. Insert each cutting into the medium so that the leaves are held just above the surface and do not touch



Pot the rooted cuttings individually in J soilless potting mix, into pots about (1cm) larger than the root ball of each cutting (see inset) Water in each cutting thoroughts and tabel

#### HARDWOOD CUTTINGS

Typical examples of plants propagated from hardwood cuttings are shrubby dogwoods (Cornus) and willows (Salix), but there is a vast range of material that can be increased in this way, including both evergreen and deciduous species. These include grapes and the climbing Polygonum (syn. Faliopia), deciduous shrubs including Forsythia and Tamarix, and the evergreen Prunus laurocerasus and Elacagnus. Deciduous and evergreen hardwood cuttings require quite different handling.

Deciduous plants are propagated from late autumn to midwinter, once the current season's growth has completely matured. Usually, the cuttings are leafless, those taken in late autumn may retain some leaves in temperate climates, but these will soon fall. Evergreen cuttings are taken at a similar time, when the leading growth bud is resting and the new growth has fully matured

Hardwood cuttings are normally much bigger than softwood or semi-ripe ones, since they are much slower to root and need additional food reserves in order to survive the winter. A standard cutting should be about 8in (20cm) long – the length of a pair of pruners. This will help ensure uniformity, which is important if you want all the cuttings.

to root and develop at a similar rate. Using your pruners, make a horizontal cut just below a node and a sloping cut away from the bud at the top – this enables you to consistently insert the cuttings the right way up

Several cuttings can usually be taken from one length of ripened, current season's growth, especially with the long stems of climbers. Always discard the thin growth at the tip and the thick growth at the base, because these are more likely either to rot or take longer to root. Take cuttings of medium thickness for the individual plant

**DECIDUOUS HARDWOOD CUTTINGS** 

Dip prepared cuttings in hormone rooting compound. (If the plant is not easily rooted, wound each cutting by taking a %-%in (1-2cm) sliver of bank from the base.) Insert the cuttings in an appropriate rooting medium, in an outdoor trench or nursery bed, or in pots in a cold frame. A slit trench (see below) is suitable for most deciduous shrubs and climbers. Choose a sheltered site, because winds can very quickly desiccate the cuttings, and remove all perennial weeds from the soil.

Well-drained soil is essential, because waterlogged soil will kill the cuttings improve drainage and aeration if

running sand along the base of the trench. Insert the cuttings so that only the top quarter is exposed, less of the cutting will be vulnerable to drying out by any cold winter or spring winds, and a much larger root system will develop firm in the cuttings after filling in the trench to make sure that there is good contact between each cutting and the soil. Check the cuttings periodically since frost will lift the plants, which will need firming in again.

they may come into leaf in the following spring before they have developed a substantial root system. At this point, it is critical that you do not allow them to dry out. Water them throughout the growing season and keep them free of weeds in order to maximize growth Lift the new plants in autumn, when they should be large enough to plant out

Where only a few new plants are wanted, insert the cuttings into 6in (15cm) pots (see below right). In colder climates, place the pots in a cold frame or, to speed up the process, on a heated bench in a frost-free greenhouse. The added protection can bring the cuttings into early growth, which often leads to the foliage being scorched and the subsequent death of the cutting. If

#### DECIDUOUS HARDWOOD CUTTINGS



I from late an early winter take well ripened shoots of deciduous shriebs or climbers (here Forsythin). Cut each shoot at the base of the current seasons growth. Cuttings taken in dutanti may stat have a few leaves, trim these off.



2 Irim off the tip of each shoot of it has not ripened. Cut the shoots into 8m (20cm) sections cabout the length of a pair of primers). Make a horizontal cut first below a node at the base of each cutting and a cut slopping away from a bud at the top.



3 Prepare a slit trench in free-draining soil
push the spade into the soil about 6in
(15cm) down and press the blade forward to
open out the trench. Dip the base of each cutting
in hormone rooting compound (see inset)



4 Insert the cuttings about 2th (5cm) apart so that about a quarter of each is visible Rows of cuttings should be 12th (30cm) apart Backfill the trench and firm the soil around the cuttings. Label, then water if the soil is dry

#### **CUTTINGS IN POTS**



If only a few cuttings are required, insert the cuttings, as in step 4, into 6in (15cm) pots of soil-based rooting medium – about four per pot Label, then place in a cold frame.

Top third

Bullion 5

4- 9-5

PP24 16 (COP2

Plasta et

. . . . . .

of each

#### EVERGREEN CUTTINGS



I by processing a hardwood cuttings have of Escaltonia), out the shoots into sections 8-10m (20-25cm) in length. Trun each cutting just below a node at the base and just above node at the top. Strip the leaves and any star shoots from the bottom half of each cutting to reduce the risk of rat



2 Insert 5-8 cuttings
(15cm) pot, so that the foliage sits just above the surface Bottom heat will speed rooting which in roually takes 6-10 weeks. Pharms the pots in a plastic tent to keep the cuttings humal is also beneficial

rooting has already started, cover the pot with fleece to avoid scorch, otherwise remove it to a cold frame or clocke to slow down new growth. Indeed, often the best way is to place the pots on a heated bench for a couple of weeks to speed callusing and then to remove them to a cold frame to continue the rooting process. This principle is followed in large-scale commercial production of fruit tree rootstocks.

For easily rooted subjects, such as willows and flowering currents (Ribes), where large numbers of cuttings are needed, insert cuttings in large, prepared nursery beds (see right). To improve drainage, either use a raised bed or pour sharp sand into the bottom of each hole before inserting the cutting. As with trenches, place the cuttings 2in (5cm) apart, in rows 12in (30cm) apart. It is best to stand on a wooden board when planting to prevent compacting the soil. The width of the board also acts as a spacing guide between rows. After inserting them, treat the cuttings as for those in slit trenches (see facing page)

**EVERGREEN HARDWOOD CUTTINGS** 

Although evergreen cuttings will root
in a sheltered place outdoors, such as
in a cold frame, they respond well to
the additional humidity provided by
a plastic tent, either in a greenhouse
or outside in a tunnel clocke. This is
because they are susceptible, unlike
deciduous hardwood cuttings, to losing
moisture through their foliage. Small
numbers of evergreen hardwood cuttings
may be rooted in pots in a greenhouse.

#### SPACE-SAVING HARDWOOD CUTTINGS



IN A ROLL. Cut a str p of black plastic about 2m (Sem) wider than the height of the cuttings. Cover it with a or (Jem) layer of peat and fine bark Space the cuttings about 3m (Bem) apart on the medium. Roll up carefully, secure with raffia, label, and water well.

◄ IN BUNDLES Prepared cuttings may be builded up and overwintered in 6-8in (15-20cm) of fine grit in a sheltered place to callus, many, here dogwood (Cornus) and willow (Salix) cuttings, will root in spring, separate the buildes and line out in a hed

(see above) Bottom heat is not usually required but speeds rooting, which is normally rapid and prodigious

Rooted hardwood cuttings of many evergreens, such as Prunus fusitanica and a Cupressocyparis leylandti, may be used for hedging. Take cuttings up to 20in (50cm) long for growing on in large pots, new plants can reach 3ft (90cm) by autumn. Reduce foliage on large-leaved subjects by up to a half to lessen the risk of botrytis and for easier handling

Using a covered nursery bed, such as in a cold frame, this is useful in colder climates for propagating some less hardy species. First mix perhite or peat and grit into the soil for a more free-draining rooting medium. Late winter into spring is the critical time, because the cuttings may not yet have many roots but the buds may come into growth early, owing to the protected environment. The secret of success is the hardening-off process.

Do this gradually, first putting just a crack of air on the cuttings, and then working toward removing the cold frames panes. Fleece is very useful for shading cuttings to reduce moisture loss on bright days before the cuttings are fully hardened. On sunny days, open the frame to prevent warm air from encouraging the buds to break early.

It may be necessary to water the nursery bed a few times in autumn and (very occasionally) during the winter. If inserting cuttings in autumn, remember to provide some form of shading. Lift and pot or plant out the rooted cuttings in the following spring or autumn, depending on their rate of growth

#### SAVING SPACE

If you are short of space, there are other ways of rooting large numbers of easily rooted hardwood cuttings (see above). Wrap them in a plastic roll and pot when they have rooted after 12-20 weeks. Store bundles of cuttings in a box of fine grit in a frost-free place to callus, and sometimes root, over winter Then plant out the cuttings in spring.



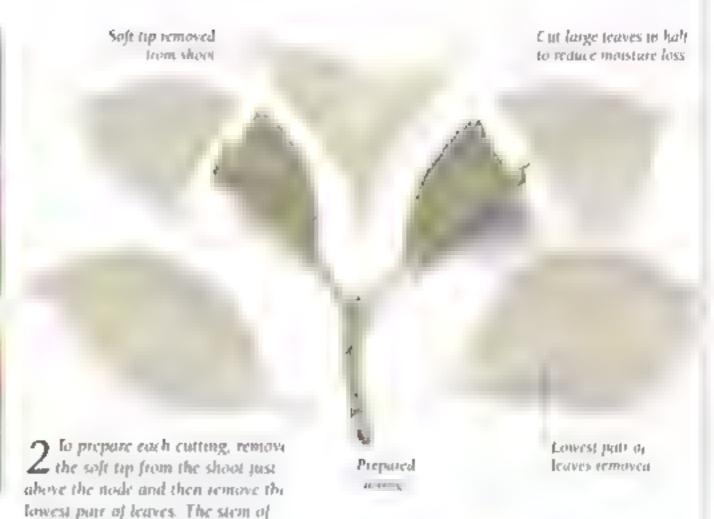
LARGE NERSERY BED

Large numbers of hardwood cuttings, here of willows (Salix), are best fined out in nursery beds, grown on for a year, then planted out

#### SOFTWOOD CUTTINGS



I in early spring to early summer, cut off nonflowering vigorous shoots (here of Hydrangea is acrophylla) with 2-3 pairs of leaves. Use pruners of out just below a node





3 Filt 5m (13cm) pots with rooting medical and space the cuttings around the edge. The teaves should be just above the surface of the medical and should not touch each other.



the are ng should be about 12-2in

tog at egention 3,

(4-5cm) in length

4 Water the cuttings with a fungicidal solution label, and place under cover Leave or a smaled place Bottom heat of 59°F (15°C) will speed the rooting process



5 Once the cuttings have rooted harden them off Gently tease apart and put individually into Join (9cm) pots. Pinch out the growing tips to encourage biothy growth (see inset)

#### SOFTWOOD CUTTINGS

Softwood cuttings are taken from the plant in spring and early summer, before the new growth has begun to firm. This method is suitable for most deciduous shrubs and climbers. Softwood cuttings should usually be 1 4–2 in (4–5cm) long with two or three pairs of leaves retained at the top (see above). Keep the cuttings in a clean plastic bag, until required, to prevent them from wilting

Remove the soft top from each cutting, because it is vulnerable to both rotting and scorch. This also ensures that, once rooted, the cutting does not immediately grow upward from the tip alone, thus ensuring a bushy plant from the start. If the tip is removed, some growth hormones also become redistributed to build up at the base of the cutting, which will assist rooting. Remove the lowest pair of leaves to make it easier to insert the cutting into

the medium. On delicate material, this should be done cleanly with a sharp knife or pruners, where there is no risk of damaging the stem with more robust plants, pinch off the foliage between thumb and forefinger. Take care to leave no snags, which may encourage rot

Inserting the cuttings correctly is important. With softwood cuttings, it is best to make a hole in the medium with a stick or pencil so the soft material is able to enter the medium with minimal resistance, thus reducing the risk of damage. Insert each cutting to just below the first pair of leaves, then firm gently around each stem. Water in the cuttings thoroughly with a fungicidal solution so that the medium is moist right to the container bottom.

The cuttings will benefit from a warm, protected environment, such as a closed case To speed rooting, provide bottom heat at a temperature of about

#### **GREENWOOD CUTTINGS**



In late spring, take greenwood cuttings from vigorous shoots (here of Philadelphus) that are firm and slightly woody at the base Prepare as for softwood cuttings (see above)



#### GROWN-ON CUTTINGS

Many deciduous shrub cuttings produce significant growth in one year. These 2-3/t 60-90cm) dogwoods (Cornus) were raised from stem-tip cuttings taken in madainmer, kept under cover over winter, planted in early subinser in mosery beds, and grown on total late summer

59°F (15°C) When the cuttings root knock them out of the container and gently pull them apart. Pot singly in 35in (9cm) pots. Pinch out the growing tips of new plants to encourage bushy growth. Grow on in a sheltered site.

#### GREENWOOD CUTTINGS

Greenwood cuttings are similar to softwood cuttings but are taken when the new growth is just beginning to firm. This material is easier to handle because it does not wilt quite so readily however, it is treated in the same way

Usually, there is no discernible difference in stem color, and therefore aistinguishing between the two types of cutting is more a question of the feel of the material. In reality, many cuttings intended to be softwood end up as greenwood cuttings - it is all a matter of timing. For most deciduous plants and some evergreens, if you miss the softwood season, greenwood cuttings root just as well, but there are a few exceptions (see pp. 118-45)

#### STEM-TIP CUTTINGS

Stem-tip cuttings, in which the soft tip is retained, are taken when the material has ripened more than for softwood or greenwood cuttings but the plant is in active growth, usually around midsummer The soft tip is then less likely to rot. This method, which can produce excellent rapid growth (see above), is suitable for most common deciduous shrubs, such as Fuchsia, Potentilla, Weigela, hlacs, and mock orange, and some evergreens, such as camelhas, heliotrope, and Hibiscus rosa-sinensis

Nodal cuttings are more likely to succeed, since some plants will not root internodally. Prepare each cutting from new growth, up to 4in (10cm) long, by making a clean cut just below a node Continue as for softwood cuttings

# DIVISION

This is a propagation technique that is associated mainly with herbaceous perennials (see pp 148-50), but it is also appropriate for a number of suckering shrubs. Where only a few new plants are needed, this method of propagation is very quick and easy. Division can be used for deciduous and evergreen genera, such as Gaultheria, Kerria. Ruscus, and sweet box (Sarrococca)

Timing is not absolutely critical, but in order to ensure success, division of suckers is best carried out when the plant is not actively growing or is dormant Early spring is ideal, the plant quickly recovers from the stress of the division because the ground is usually moist, and, although the soil is warming up, the air temperature is not yet too high. Summer is best avoided because the new plants will be prone to wilting and scorch in the hot sun

Most shrubs produce suckers on long underground stems (stolons), a few, such as roses (see p.113), sucker from the main stem just above the roots. When separating suckers from the parent plant (see below), use a fork to lift the underground stem that runs

between the suckering shoots and the parent plant. If the sucker has fibrous roots at the base, it may be propagated. sever the stem close to the parent plant and prepare each sucker as shown below

Replant the rooted suckers directly into soil that has been prepared with well-rotted manure or compost. Firm and water in each sucker. Alternatively, pot the suckers in potting mix in 2-3in (5-8cm) pots. Water the suckers regularly until the new plants are well established. With plants such as snowberries (Symphoricarpos) that are usually prone to leggmess, cut back suckers to 12-18m (30-45cm) to ensure

bushy regrowth

Shrubs that have a clumping habit may be divided in a similar way to herbaceous plants (see p 148). Lift the entire clump, divide into good-sized pieces with healthy roots and topgrowth using a spade or sharp kmile and discard the rest. Division of this sort may also be used to rejuvenate a mature shrub that has grown beyond its designated area, a common example of this is Sorbaria sorbifolia. Prepare and grow on the divisions as for suckers



I in early spring, lift an underground stem with I such as on it, without disturbing the parent plant (here a Gaultheria shallon). Check that there are librous roots at the base of the suckers



1 Listing a sharp pair of printers, remove the Long, suckering sten by cutting it off close to the parent plant. Firm back the soil well around the base of the parent plant



Cut the main stem back to the fibrous roots I then divide the suchers so that each has its own roots. Cut back the topgrowth by about half to reduce moisture loss



4 Replant the suckers in open ground or in 2-3in (5-8cm) pois. Firm the soil well around the suckers, water in and label Water regularly while the suchers are establishing

# SOWING SEEDS

There are many shrubs and climbers that can be grown from seeds, with always the chance of creating something new. The sense of excitement as germination takes place and seedlings appear is the same however long it takes, be it a Daphne requiring a winter's chill or an Abitilon that needs only a warm, moist soil mix in spring Remember that only species "come true" from seeds, a plant grown from seeds gathered from your favorite Caryopteris cuitivar is unlikely to have exactly the same characteristics as its parent

shrubs and climbers have three basic types of seedhead nuts or nutlike fruit containing often short-lived seeds with a high water content (such as Corylus) capsules or pods that enclose smaller drief seeds (such as Cytisus), and fleshy fruits and berries (such as Viburnim). The first consideration when gathering seeds is that the plant from which you propose to gather must be healthy and vigorous. Plants showing a lack of vigor will often be harboring viruses, which can be transferred by seeds.

#### NUTS AND NUTLIKE FRUITS

Nuts and nutlike fruits generally ripen in autumn, they should be gathered when they would naturally fall, or just immediately before. Gather them by hand-picking, alternatively, if the plant is large enough, place a sheet of cloth or plastic around its base and shake the branches until the nuts fall onto the sheet. Remove the nuts from the outer casings, clean, and sow at once in deep pots. Discard any nuts that show the slightest imperfections.

Alternatively, store the cleaned seeds in moist peat in a bag hung up in a garage or shed and out of reach of rodents (or in a refrigerator), and sow them in late winter to spring. This is

#### GATHERING SEEDS FROM RIPE BERRIES



I For berries with large seeds there Mahoma)

I put a handful into cheeseeloth or mustin

twist to secure, and hold under cold running

water Squeeze until no more fince runs out

advisable in areas where the soil is poorly drained and there are usually above-average levels of winter rainfall

#### PODS AND CAPSULES

Dry seeds that have been collected from pods or capsules are easier to handle than the moist seeds found in nuts and nutlike fruits, if stored correctly, they will retain their viability for many years. Check suitable seedpods daily as they begin to ripen, they are usually ready for gathering once the pod starts to turn from green to brown.

Always gather pods or capsules when the weather is dry, since moisture will increase the likelihood of fungal attack Before gathering medium-sized or large seeds, open one or two of the seedpods to see if there is in fact a developed seed inside Ripe, viable seeds are plump healthy, and usually still green

Place the pods in a paper bag and seal it tightly. Alternatively, spread the pods on newspaper in a tray and cover



2 Open out the cloth carefully and pick out the seeds from the mashed pulp. Allow them to dry on some paper towels at blotting paper in an any place for a comple of days.

them with fleece or more newspaper pods often "explode" to shed their seeds
in all directions

Some substitubs that produce flower spikes may be treated as if they were herbaceous perennials, cut off a complete spike of seed capsules and hang it upside down in a paper bag. After a few days, shake the drying seeds free. Do not be tempted to extract seeds that remain in the capsules, since these are likely to be unripe and nonviable.

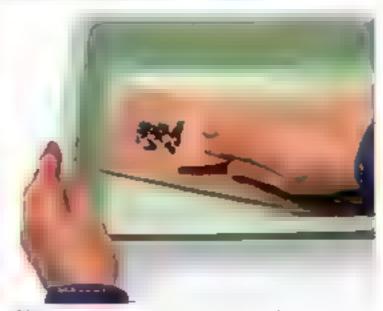
After extracting the seeds, clean off any chaff attached to them, since such material is likely to rot, increasing the likelihood of damping off (see p 46). Remove the worst of the debris by hand alternatively, run the seeds through a series of sieves (see p.28) until only clean seeds remain.

Store dry seeds in a refrigerator. Place them in a clearly labeled paper bag or envelope inside a plastic box or cookie tin. To maintain a dry atmosphere, first place silica gel in the bottom of the tin.

#### SCARIFYING SEEDS OF SHRUBS AND CLIMBING PLANTS



USING A KNIFE Nach the hard coat of vers targe seeds (here of Paeoma delavay) van lutea) with a sharp kinfe (see inset). Take care not to damage the "eye" of the seed or to cut too deeply



USING SANDPAPER Place smaller, hard-coated seeds (here of Caragana brevispina) between two sheets of sandpaper in a seed tray and rub them to scratch and weaken their surfaces



Using not water To soften the seedcoats of smaller seeds (here of Sophora davidn), place in a bowl and pour boiling water over them Allow to soak for 24 hours, then sow at once

#### SOWING SEEDS IN CONTAINERS



I full a tray with seed soil mix furni gently, water, and allow to drain. Sow the seeds evenly over the surface by tapping them from a folded piece of paper



2 layer of soil mix, then add a san (Soil ) layer of grit. Label and cover with wire neiting to protect the seedlings. Place in a cold frame



3 Once the germinated seedlings are large enough to handle the them carefully, using a knife or similar implement. Always hold the seedlings by their leaves

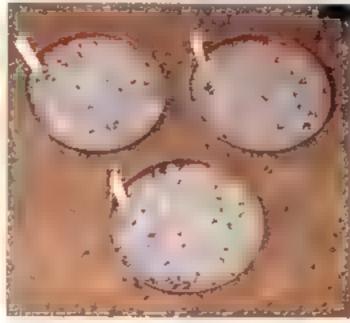


4 Insert the seedlings singly into 22-32in (6-9cm, pois, or in rows into trays, in soilless poiting muc Gently firm around the base of each seedling Label, water

#### COLD STRATIFICATION OF SEEDS



BEFORE SOWING Seeds that are stored before sowing (here of Aroma melanocarpa) can be challed as a refrigerator Put them in some most vermiculate or peat in a clear plasme bag, tabel, and store for 1–3 months



AFTER SOWING Seeds that are sown fresh such as clematis, can be plunged in a sandbed or cold frame outdoors over winter. Sow seeds thinly in pans of gritty seed soil mix, then cover with a fine layer of mix and one of grit

#### FLESHY FRUITS AND BERRIES

These are usually hard and green and, as they upen, soften and change color, often from yellow to red. The important thing is to watch out for the turn. If you leave it too late, the soft, succulent fruit may be taken by birds. Gather fruits by hand-picking or shaking the plant

Removing the seeds from fruits or berries can be achieved in many ways Squeeze berries in cloth (see facing page), gently mash them through a sieve, then wash off the pulp. Alternatively, put fruit in water to rot, then mash the pulp and place in clean water. The pulp and dead seeds should rise to the top while viable, heavy seeds settle on the bottom. Whichever method you choose dry the seeds on paper towels for a couple of days before storing them.

With members of the rose family (Rosaceae), it is frequently best to layer whole fruits in coarse sand in a tray or in a large pot and leave them outside for the winter. Keep the sand moist. This provides the period of chilling needed before many of this family.

germinate. In late winter or early spring, remove the decomposed fruits from the sand

#### SCARIFICATION OF SEEDS

Many shrubs and climbers, especially members of the pea and bean family (Fabaceae), have hard seed coats that prevent germination until the coat is broken down to admit moisture to the seed within. There are several ways to deal with this problem, these are known as scanfication and involve nicking or abrading the seeds or soaking them in hot water (see facing page)

Nature softens hard seed coats by subjecting the seeds to warm, moist conditions in spring, when bacterial activity is at its height. This can be mimicked by storing the seeds in moist soil mix and hanging them up in a shed during the summer. In commerce, for roses particularly, compost activators may be added to speed up the process.

Some impermeable seeds have chemical germination inhibitors on the seed coats, remove these just before

sowing by soaking the seeds in hot water, mild detergent, or alcohol. Wash the seeds thoroughly afterward.

Some seeds need several treatments for multiple dormancies; scarify them first to allow other treatments to take effect. A safer option is to sow the seeds outdoors and let nature take its course.

#### STRATIFICATION OF SEEDS

Some seeds are prompted to germinate by temperature changes. Many woody plants native to temperate climates exhibit cold-temperature dormancy, where seeds require a winter's chilling before germinating in spring. This can be overcome by storing the seeds in a refrigerator at 41°F (5°C) before sowing, or by sowing in autumn and overwintering outdoors (see left). Even seeds that do not need winter chilling may germinate more quickly and uniformly after a short period of cold stratification.

Some hard-coated seeds require a period of warm stratification. Place the seeds in a plastic bag in an equal volume of sand and leaf mold, or an equal volume of peat and sand, and store for 4–12 weeks at 68–77°F (20–25°C). This is usually followed by cold stratification before sowing

#### SMOKE TREATMENT OF SPEDS

In nature, some seeds germinate only after a bush fire. The flames scarify the seed coat, and chemicals in the smoke stimulate germination. To simulate this, sow a tray of seeds, cover with 2%—4in (6—10cm) of dry leaves, burn them, and water in the ash. Kits, smoke paper, and smoke water containing chemicals found in smoke may also be available

#### SOWING SEEDS IN CONTAINERS

Most seeds of shrubs and climbing plants are best sown in containers (see above), so that the conditions they need can be easily provided. Seeds that need a period of chilling or take more than a year to germinate, such as Daphne, can be sown in autumn (continued on p.104)

# VERNICULITE L se a Am (lem) layer of vernicular te over lasa germinating seeds, usually of climbers or tender shrubs. Vermicular to reach the seeds and keeps them moist which compo

(continued from p.103) and overwintered in cool chimates in a sheltered place, such as a sandbed or cold frame. (In areas without cold winters, such seeds should be strainfied in a refrigerator, see p.103.). Other seeds germinate readily from a spring sowing, these are treated in the same way as bedding plants or easy herbaceous perennials, and the seedlings are suited to the controlled atmosphere of a greenhouse. Abatilon, for example, responds well to this treatment

#### SOW NG THE SEEDS

Fill seed trays, seed pans, or pots with a good-quality, gritty seed soil mix (see p 34), containing only a little fertilizer – too much can kill seedlings. Thoroughly water the mix before sowing

For small or medium-sized seeds firm the soil mix to leave a Ain (3mm) gap between the mix and the rim. For large seeds, the gap may be 4- Ain (10-15mm). Sow the seeds and cover with a fine layer of mix. Then add Ain (5mm) of coarse sand or fine grit (see above right) for autumn-sown seeds. For spring sowings, instead of grit use a Ain (1cm) layer of vermiculate (see above left) fine-grade for small or medium-sized seeds, medium-grade for large seeds.

Some seeds, such as rhododendron seeds, are so fine that they do not have sufficient food reserves to push through the soil mix, or they require light in order to germinate. Sow such seeds on the surface of mix that has been sieved tiny seeds can easily fall between cracks of a coarse surface. To give the seedings as much light as possible, leave only a fraction of an inch between the soil mix and the rim. Mix the seeds with a small amount of fine sand, then gently tap the mixture onto the soil mix to sow evenly.



GRIT Cover slow-germinating seeds, mostly of hardy species, with fine grit or coarse sand to allow seedlings to grow healthily (see right) If soil mix is exposed for a long while, it is susceptible to growth of moss and liverwords which competes with seedlings (see left)

#### **AUTUMN-SOWN SEEDS**

After sowing, label the containers and cover with wire netting to protect the seedlings from birds or animals. Place in a sheliered place (see below) to overwinter at 14–28°F (-10 to -2°C) and subsequently germinate. Check them regularly and water if necessary.

When the seedlings are large enough to handle, they should be transplanted individually into cells, trays, or small pots (see p 103). Take care not to disturb their roots. This may be in the first spring after sowing, or up to a year after germination. If then grown on under protection as before, the new plants should make rapid growth.

#### SPRING-SOWN SEEDS

A temperature of 59-68°F (15-20°C) is required for germination, unless otherwise stated (see A-Z of Shrubs

and Climbing Plants, pp.118–45)
The surface of the soil mix must also remain moist at all times, either place the container in a closed case, under a plastic tent, on a mist bench, or cover it with a sheet of glass. Some seeds require bottom heat for successful germination; for these, a propagating blanket (see p.41) covered with capillary matting works well

temperatures above 68°F (20°C) respond well to being placed on a mist bench, but seeds requiring temperatures higher than this often struggle to germinate, owing to the cooling effect of the mist

inspect the soil mix regularly to check that it has not dried out, and water as necessary. Never water a container from above once fine seed is surface-sown, place it in a shallow dish of water for a short time. Spray the seedlings occasionally with fungicide

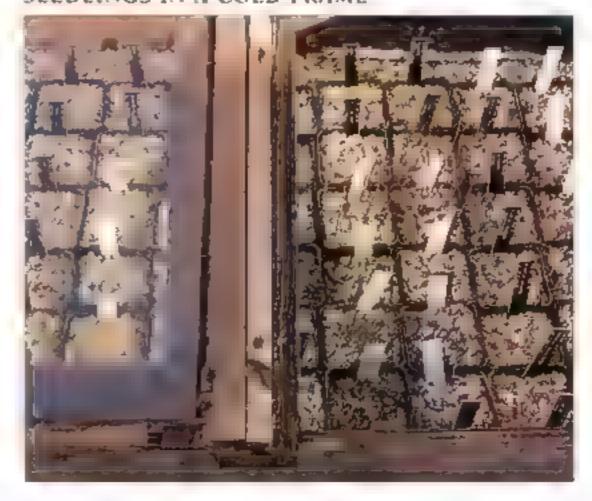
When the seedings are large enough to handle, transplant into trays or pots in low-nutrient potting mix, as for autumn-sown seeds. Place out of direct sunlight until established. Harden off young plants by gradually exposing them to outdoor conditions.

#### SOWING IN RAISED SEEDBEDS

Seeds of some shrubs and climbers, especially those native to your area, can be sown outside in raised seedbeds

Select a sheltered site and raise the soil level by 8in (20cm) to improve the drainage. Remove perennial weeds and dig the soil thoroughly. Large seeds can be sown in rows in autumn smaller ones can be left until late winter. Cover with 4-1/in (2-3cm) of pea gravel. Do not allow germinating seeds to dry out, cover with fleece or loose leaves to reduce frost heaving. (See also Garden Trees, p.55.)

#### SEEDLINGS IN A COLD FRAME



Some seeds, especially of hardy shrubs or climbers, require a period of watter childing before they will germinate. In colder climates, place containers of seeds in a cold frame after autumn sowing. The cold frame aflows exposure to cold while protecting the seeds from distarbonce by buds. animals, or the chements. Once the seeds germinate, the seedlings can remain in the cold frame for up to a year before being transplanted

# LAYERING

In nature, many plants reproduce by layering, a process where roots form at the point at which a plant's stem touches the soil. Some plants have shoots that trail along the ground, such as snow-berries (Symphoricarpos) or heathers (see p. 111), others with an upright habit may suffer storm damage that causes a branch to fall to the ground while remaining partly attached to the plant

Layering is like rooting cuttings that are still attached to, and are protected by, the parent plant, and consequently does not require as controlled an environment to succeed (unless layering a tropical plant in a cool climate). Many shrubs that are difficult to root from cuttings such as smoke bush (Cotinus) and hizels (Corylus), respond well to layering. Layering requires less skill and altereare than grafting, which is often used for plants that are difficult to root

If only one or two plants are wanted air or simple layering can be used to propagate many shrubs or climbers quickly. Other forms of layering produce greater numbers of new plants, or layers

#### AIR LAYERING

Air layering is normally used when it is not possible to lower a branch down to ground level. It can be successful in a wide range of shrubs and climbers, from the tender rubber plant (Ficus elastica Decora') and philodendrons to many hardy species. This technique can produce a Daphne large enough to be planted straight into the garden within 12 months. Plants are best air layered in spring for replanting in the autumn or the following spring

Layers may be made on wood of any age, but material that is 1–2 years old produces roots more readily (see below) Select a straight branch and trim off any leaves and sideshoots to leave about 12in (30cm) of clear stem. Wound the stem by making a sloping cut into the center of the stem to create a "tongue" Alternatively, remove a band of bark — hin (5–12mm) wide by scoring two shallow, parallel cuts around the stem and peeling off the bark. Apply hormone rooting compound to the wound to encourage rooting

Tuck some moist sphagnum moss into the sloping cut of the wound to keep it open, using the reverse of a knife blade. Enclose the wound in a black plastic sleeve, secured below the wound, to keep out moisture and prevent growth of algae. Pack the sleeve with sphagnum moss, then secure it above the wound. Alternatively, use clear plastic wrap for the sleeve and cover it with black plastic or aluminum foil.

Leave the layer in place, occasionally removing the plastic sleeve to check for rooting, which should occur within a year. When roots have developed, sever the new plant below the wound and pot or replant it. Water in well at planting time, and again throughout the first summer until it is well established. In colder chimates, in the first few weeks cover the plant with fleece to protect it from the elements.

For tender plants that are grown under cover in cooler regions, the technique is identical, but rooting takes place more quickly, new plants can be ready for potting within 2-3 months

#### AIR LAYERING SHRUBS AND CLIMBERS



In spring, choose a 1-2-year-old shoot that is straight healthy, and vigorous there of a thododendrot.) Iron off sideshoots and leaves for about 12m (30cm). Do not leave any snags



2 Wound the stem, making a 1 nm (3cm angled cut toward the shoot tip (see inset apply hormone rooting compound to the wound Pack it with a furte moist sphagnum as an



3 Wrap the stem toosely with black plast of Seal it around the stem and below the way I wan tape. Pack the stems with moss to cover the wound.



4 Seal the upper end of the steeve around the steem with more tape. Black plastic retains moisture without encouraging growth of algae. Leave the layer in place for up to a year. Check it accasionally for signs of rooting.



When strong new roots have formed, carefully remove the plastic sleeve Cut through the stem just below the root ball. Tease out the roots, but do not lev to remove all the moss For rhododendrons, prime back new growth to one bud above the old wood Pot the laver in souless potting mix or plant out in prepared soil. Water well and tabel

#### SIMPLE LAYERING

When you want only a couple of new plants, simple layering is a good way of propagating a wide range of shrubs and climbers quickly. You can do this at any time of the year, but the best times are autumn and early spring. The plant shoots of most climbers can be simply pegged onto the surface of the soil to root, while the stiffer stems of many shrubs require a trench.

For most climbing plants, choose a shoot no more than two years old and 2–3ft (60–90cm) long that is growing horizontally and close to the ground and is supple enough to be pinned down and then bent upward at a right angle. Avoid very thin stems and thick watershoots. If no suitable material is available, prune the plant back hard to encourage more vigorous new shoots.

Before securing the layer prepare the ground next to the parent plant where the shoot reaches the surface by digging it over and incorporating into it some free-draining rooting medium to a depth of 12in (30cm). Make sure that the

medium is mixed thoroughly into the soil, rooting medium quickly dries out if exposed to the air

from the layer for 12in (30cm) behind the growing tip (see below). Wound the underside of the stem of the layer about halfway along its length, or through a node, by making a slanting cut through to the middle of the stem, to form a "tongue". Alternatively, twist the stem to damage the bark or remove a 1in (2.5cm) sliver of bark from the underside of the stem. Ireat the wound with hormone rooting compound.

Remove some of the enriched soil from underneath the layer before pinning it down securely with several long, galvanized-wire, U-shaped pins or staples on each side of the wound ideally, you should pin the layer down at the point where one-year-old wood joins older wood. In practice, this is not always possible since the branch may not be long enough. Mound up soil over the layer to a depth of 3 in (8cm) and firm — otherwise as the soil settles it will

leave the stem exposed. Bend the tip of the shoot so that it is as close to vertical as possible, and attach it to a stake. The angle created by bending the shoot aids rooting by concentrating the growth hormones at the rooting site instead of the growing tip. As the shoot grows continue to tie it in loosely. Water the layer well, and check it weekly during the summer to ensure that it does not dry out. Keep the area free of weeds

Some plants root quickly, but most take at least a year. Do not be too anxious to separate the layer from its parent, since it is crucial for the young plant to establish a good root system. When well rooted, sever the new plant and either pot up or plant out directly.

When layering a shrub (see below) select a pliant shoot and prepare the stem as for climbers. Use a stake to mark where the stem touches the ground. Dig a sloping trench, 3in (8cm) deep, and peg the shoot into the bottom Bend the shoot to as near vertical as it will go, and tie the stem tip to the stake Backfill the hole, firm, and water in

#### SIMPLE LAYERING OF A CLIMBER



In autumn, select a young, ton growing shoot (here of Akehia quinata) Remove leaves and side shoots from at least 12m (30cm) of the stem behind the shoot up



2 to a seen ingest up to fine the shore in the middle fithe to a real house in the middle fithe to a real house it is a make a



3 Use a brush to dust the wound with hor nor coting compound, here powder (see inset). Shahe off any eyess.

### SIMPLE LAYERING OF A SHRUB



1 Mark the position where the stem touches the soil with a stake. Dig a sloping trench about on (8cm) deep leading from the stake toward the strub.



4 Peg the clean length of stem.

wounded sule described the soil with wive stapies. Mo and up the soil to a depth of 3m. Sem over the shoot. Stake the tap of the shoot to keep it up 13m.



5 Once it has moted, usually in the following a itamin sever the layer close to the parent plant and lift the layer with a hand fork. Out away the old stem on the layer back to the new roots.



6 Pot the new plant intervalless potting mix, water well and label. Plant it out when well established. Alternatively, you can plant it directly into its permanent growing pas in a



Peg the prepared stem into the base of the trench with wire staples. Bend up the stem tip and the it to the stake Fill in the hole, lightly firm, and water

#### SELF-LAYERING A CLIMBER



I where a shoot (here of an two, Hedera) has rooted into the ground and is producing healthy, new growth, carefully lift it, asing a hand form With primers, sever the self-layered stem from the parent plant, catting straight doors the stem just above a node

#### SELF-LAYERING

Some plants, such as tytes (Hedera) and some of the smaller-leaved, low-growing cotoneasters, naturally layer themselves their sprawling stems rooting into the ground as they grow. To propagate them, it a rooted shoot with a hand fork sever it with pruners, cut into rooted sections, and pot singly (see above)

Alternatively, remove a rooted sideshoot, or layer, by cutting through the main stem on either side with a spade. Well-rooted layers may be planted out; this is best done in early spring, when the layers will establish quickly in the warming soil. When planting, prepare the ground thoroughly and water in well. In colder climates, protect the new plants with fleece for a few days while they establish.

#### SEAPENT NE LAYERING

This is useful for plants that produce long shoots of new growth each year, including many climbers such as clematis, golden hops, grapes, and wisteria. In effect, it adapts the process of self-layering and makes it possible to obtain quite a few layers from one shoot in early spring, prepare the ground as for simple layering (see facing page), take one of the previous year's shoots, and bring it to ground level. If the stem is very thin there is no need to wound it, but wounding speeds the process

Wound the stem between the nodes and "snake" the shoot in and out of the soil (see above right), pinning the wounds below the soil with wire staples so that at least one bud remains above ground between the layers. Alternatively, wound just behind a node, or even through it, and "snake" the shoot along the soil surface, pinning the stem over the wounds. Often layers root by autumn, but some take until spring When the layers are well rooted, treat them as for self-layering (see above)



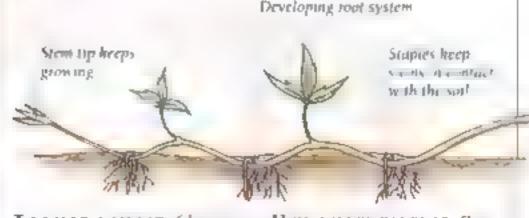
2 sure cach has a good toot system and string new growth Remove the lower leaves from each section, cutting close to the main stem. Sections with just one or two leaves (see top right) can be used but will take longer to establish



3 Pot each layer individually using so hess porting mix. Water well and label. Grow on in a sheltered spot outdoors with the new plants become established. Sections that are arready well rooted can be planted directly into their final positions.

#### SERPENTINE LAYERING OF A CLIMBER





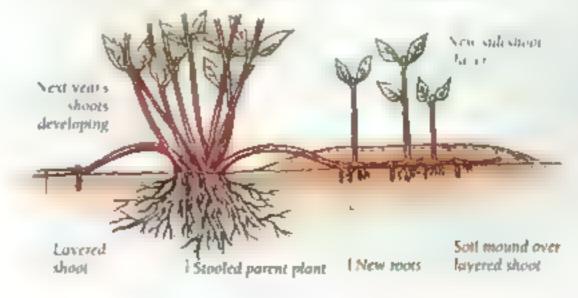
TO LAYER A SHOOT Choose a healthy tracing shoot and tranoff the leaves and sideshoots. Wound the stem between each mode (see above) or just behind the growth bads (see left). Apply hornime rooting powder to encourage rooting, then put the stem to the ground, over the wound, with wire staples.

How layers develop Once the stem is an contact with the stomal, the words stem that moring. Nutrients for this process are provided by the parent plant as the growing tip of the shoot draws sap along the layered stem (see above). The layers each with roots and a shoot can be severed when tooted.

#### FRENCH LAYERING A SHRUB

French layering of ornamental shrubs is not often undertaken commercially because of the length of time it takes, but it is worthwhile for the gardener: it is very reliable, especially for shrubs that are difficult to root. It involves cutting back a vigorous, young stock plant to 2in (5cm) in spring to encourage formation of long, new shoots, a process called stooling (see p.24).

The following early spring, frim the growing tips and pin the shoots down on prepared soil so they radiate from the parent plant like spokes on a wheel. As sideshoots grow mound them with soil (see below). Water and weed the layers regularly. In autumn, It and sever the rooted layers from the patent for potting or planting. The shoots at the center can be layered next year.



RECOTING LAYERS
Pin down each shoot
of the previous
season's growth
When the stateshoots
are 2 4-3 in (6-8cm)
tall, mound soil over
them, leaving the
tips exposed. Mound
again later in the
summer to a depth
of 6 in (15cm)

# GRAFTING

Grafting is often used for cultivars that are difficult to propagate by other means or to produce a plant more quickly. There are many different types of graft. For most shrubs and climbers, the best choice is apical-wedge grafting (see below). This graft provides consistently good results and is one of the easiest to perform. Other grafts suitable for shrubs and climbers include whip grafting and spliced side-veneer grafting (see facing page).

The first requirement is a goodquality rootstock, that is, a plant of a species compatible with the cultivar to be grafted. Usually this is a one or twoyear-old seedling, but with magnohias and rhododendrons, stocks can also be raised from cuttings. For summer grafting, stocks must be containergrown, for winter grafting, they can be either container-grown or bare-root

If raising only a few rootstocks, transplant seedings into deep, square 3%in (9cm) pots, to provide space for the all-important root system to develop With some plants, the seeding will have grown sufficiently to graft in the first summer or winter Normally, the stock is ready when its girth measures %—win (6—10mm), but it is more important that

the stock girth matches that of the scion (see p.27) Particularly in summer, stock and scion should be at a similar stage of growth. Keep the soil mix of containergrown stocks just moist for two weeks before grafting so that the union is not flooded by an overactive flow of sap, which will stop it uniting with the scion

Always take scions from cultivars that are true to type, free of pests and diseases, and still producing good levels of extension growth (new shoots that increase the plant's size) annually. The length of the scion depends on what is available, but 3-5in (8-12cm), with two to four healthy buds, is usually best There is no strict rule as to the girth, but anything less than Min (8mm) is difficult to work with. Where new growth is limited, try smaller scions, but a good union is less assured. If new growth is poor, use two-year-old wood, this produces very acceptable results with Hibiscus and some other general

It is vital not to let the scion material dry out, so unless it is used immediately store it in a plastic bag in a refrigerator, where it will stay fresh for up to a week Making accurate grafting cuts is crucial to success, so practice making the cuts on other shoots, such as willow, first

#### APICAL-WEDGE GRAFTING

When preparing a scion (see below), imagine you are making a sharpened spear. Make an angled cut at the base, normally starting just above a bud and exiting at the center of the stem base. Move the knife slowly through the stem to perfect an evenly slanting cut. Repeat on the other side of the stem to create a symmetrical wedge.

The cambium layer, a band of thinwalled cells between the bark and the wood and essential to the success of the graft, should now be exposed. Remove any weak or unripe terminal buds at the top of the scion. With some material, such as wisteria, it is possible to create several scions from one length of wood.

To prepare a rootstock, clean and dry
the stem, then head it back to just above
the roots, cut straight across the stem
and leave just enough for easy handling
If the cut is at all uneven, slice of a thin
layer to neaten the surface. Make a
vertical slit in the newly cut surface of
the stock to a depth sin (2–3mm) shorter
than the scions wedge. Where the stock
and scion are of a similar girth, make the
cut on the stock in the middle so that the
cambium layers match up exactly, if the
scion is smaller, cut the stock off-center

#### APICAL-WEDGE GRAFTING



I luke scions from ripe, healthy shoots of the current season's growth, with good buds at the tips and closely spaced nodes



2 from a seron shoot to 4-6in (10-15cm) with 4-6 nodes Make two slanting cuts, %-1 orn (2-3cm) long, at the base (inset)



3 theid back a pair 1 of stack

plant reset libraria symmetry

to line 1.5 m) above the metric on

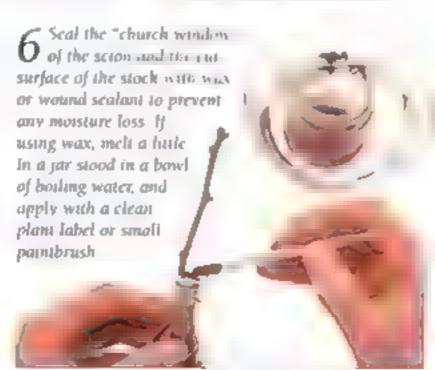
- 1 an co. 3 m) a to the sten



4 Push the wedge-shaped base of the scion carefully into the cut on the stock. Make side that the cambining of stock and scion meet



S Rind the graft with a narrow rubber band, cut to form a strip Wrap it from the top of the stock to just below the graft If the scion bud around it. Tuck in the end of the rubber band to secure it.





Lay the grafted plant in a seed tray, with the secon resting on the rim. Cover the roots and graft with moist soil mix. Label

#### COMMON TYPES OF GRAFT

WHIP GRAFT If motstock and scion (here a Pittosporum) have closely stimular girths, a simple slanting cut on each can be made. Place together so that the cambi imis on both sides of the graft neet. The senti-ripe or hardwood scion should be 3-4 a (8-10cm) long it possible with a bud at the base

1-1 sin (2.5-3cm) oblique s uty on se on and stock

2-3in (2.5-8cm) moostock

to make a narrower incision and ensure the cambiums match on both sides. Another option is to match cambiums on one side only (see facing page). Push the scion gently into the slit in the stock, all the way to the bottom, this should leave a little of the cut surface of the scion exposed – the "church window" – to let excess sap escape.

Strips of elastic bands are ideal for holding the graft together while the union calluses. Apply even pressure as you wrap the band around the stem and take care not to misalign the cambiums Normaily, only sufficient pressure is applied to hold the graft in place, but if the graft is poor, pull in the stock to make improved contact with the scion

Apply a commercial grafting wax or wound sealant to the union and to the top of the scion if it has been cut You can also tie in the graft with plastic grafting tape, making the use of wax unnecessary

#### OTHER TYPES OF GRAFT

Where stocks and scions have similar girths, whip grafting and spliced side-vencer grafting are good alternative methods (see above). The principles of grafting are the same, but the carpentry involved in fitting together stock and scion may differ (see pp 118–45 for individual plant requirements and p 27)

#### AFTERCARE OF GRAFTED PLANTS

This is crucial to success. The graft is sensitive to drying out, but watering the pot could flood the union and cause rot, so house the graft in a closed case or tent it under plastic to provide a warm humid environment. Maintain a temperature of 64–68°F (18–20°C) which in winter usually means placing the grafts on a heated bench (see p.41). Water the sand or capillary matting well before placing the grafts on the bench In summer, shading is essential to prevent scorch.

Scion from serror-ripe shoot SPLICED SIDE-VENEER GRAFT from any leaves from the lower stems of a 4-5m (10-13cm) scion and a rootstock there of thododendron) Make a Stock is not CHI but it downwant mick In .2 5cm) from the base of the stock and a lin-Scion sits on "shoulder" of (2 Scm) stoping cut to cust an stock meet it Remove the wood. Make a matching

To prevent fungal disease, air the plastic tent or propagating case first thing every day for 5–10 minutes, drying off any surface moisture that has condensed on the rootstock. Take care too much ventilation too early on will dry out the union

cut on the secon see

mser) and fit together

Callusing is the first sign of a successful graft union and usually begins after 3-4 weeks. Soft white tissue appears around the edge of the union on and around the church window, and also along the length of the cut in the stock. At this stage, the graft should be hardened off in preparation for moving onto the open bench. Open the case a fraction of an inch overnight, and increase the exposure by degrees over a period of up to four weeks. During this time, the callus will turn from white to yellow and brown, hardening as it changes

Never move the grafts on a warm bright day. When they are taken out, shading may be needed and the surfaces around the graft should be damped down for the first few days. Begin watering very spannigly, Pot bare-root grafts only when they are clearly successful, each in a container a little larger than the root ball. Growth is often prodigious, especially in protected conditions; a grafted plant is usually large enough to plant out the following autumn or spring

#### HOT-PIPE CALLUSING OF GRAFTS

this process, used commercially on a large scale, applies hot air to the graft while the rootstock and scion are kept frost-free and contained therefore less hable to dry out. This enables the callus to form quickly, giving flexibility to the commercial grower and making it easier for the gardener to achieve success with difficult subjects, such as dogwoods (Cornus) and hazels (Corylus). All types of graft respond well, whether on hare rooted or container grown stocks.

A small-scale hot pipe may be made in a cold greenhouse or a shed. You need a length of 3m (8cm) plastic drainpipe, soil warming cable that is twice the length of the pipe with a thermostat and control box and an electricity supply. Cut I in (2.5cm) wide sections to half the depth of the drampipe to create slots at the spacings shown below. Double up the cable inside the pipe and tape it to the bottom. Raise the pipe up slightly on wooden blocks.

Melt some grafting wax until it is just warm to the touch, dip each graft and all of the scion in the wax to seal it and prevent desiceation. Place the grafted plants in the hot pipe, as shown below. Set the thermostatio maintain a temperature of 68–77°F (20–25°C) within the pipe. Successful grafts should callus within three weeks.



Lot In (2.5cm) wide slots in the pipe. Iin (2.5cm) apart for bare-root, or Jin (8cm) apart for pot-grown, rootstocks. Place each plant with its grafted area inside a slot



2 Cover bare roots with moist soil to prevent drying out Lay some capillary matting over the slots and secure with insulating tape

# HEATHS AND HEATHERS

There are three principal genera of these shrubby evergreens: Calluna, a heather with only one species but many cultivars, flowering from midsummer to ate autumn, Daboecia a heather with two summer flowering species, of which only D cantabrica is grown in gardens, and Erica, a heath that includes many winter- and summer-flowering species and cultivars. Heaths and heathers range from groundcover plants to tree heaths up to 20ft (7m) tall. The majority need moist, acidic soil and full sun or an exposed site. Propagation of cultivars is vegetative, by layering or cuttings, because the seeds do not come true.

#### TAKING CUTTINGS

Of all the heathers, cuttings from Daboecia and Erica root most readily and are least prone to disease. Take semi-ripe cuttings (see below) from healthy, vigorous, nonflowering shoots

Some heaths are rarely out of flower so it may be necessary to take cuttings of flowering shoots (see below right). Cuttings of the Australasian native heath (Epacris) are taken in early summer, as well as after a flowering flush.

Commercial nurseries do not remove leaves from cuttings, but it is a useful precaution against rot. Do not bother stripping off the tiny leaves of calluna shoots. Insert the cuttings in a welldrained and aerated medium. Rooting hormone is not needed. Do not use nitrogenous fertilizer in the medium heaths and heathers are sensitive to the salts that these preparations contain Species and cultivars root at differing rates, so insert the cuttings individually in cells, or several of one species or cultivar to a 5in (13cm) pot. For best results, root the cuttings in an enclosed space at 59-70°F (15-21°C) Heaths and heathers are prone to rot, so spray

or water in a general fungicide and remember to ventuate the cuttings daily.

Pot up rooted cuttings singly before hardening them in spring (see facing page) Water the cuttings from below only when the medium has almost dried out to avoid problems with algae, liverworts, and mosses growing on the surface of the medium

Alternatively, root the cuttings in a prepared bed in a sheltered place, such as in a cold frame; site the frame in the shade to avoid extreme variations of temperature affecting the cuttings. After 4–6 months, grow them on in a nursery bed with free-draining soil, or pot them singly. Leave in a sunny position until autumn, when they may be planted out

Heaths and heathers are susceptible to vine weevils, apply a nematode drench in midsummer to the young plants and again in early autumn if they have not yet been planted out

#### SEMI-RIPE CUTTINGS

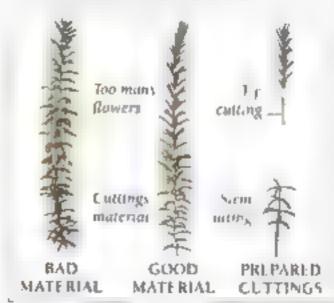


1 From late summer to autumn, select a strong healthy, nonflowering sideshoot (here of Calluna vulgaris 'Robert Chapman') Remove it with clean pruners, cutting straight across the stem about 4in (10cm) below the stem tip



2 The cutting on the right, with its compact even growth, should make a good plant. The two cuttings on the left are unlikely to be successful. They are weak and spindly, and the presence of flower bads will inhibit rooting.

#### FLOWERING SHOOTS



Choose a shoot of Erica carnea that has only a few flower buds concentrated on one part of the stem, and take 2th (3cm) cuttings one at the base and one from the tip. Prepare the cuttings (see steps 3 and 4 below)



3 Irim each stem to a length of about 1/2-2in (4-5cm) Holding the base of the cutting firm with your finger, cut straight across the stem at the appropriate point with a clean, sharp kings



4 Strip leaves from Erica and Daboecia cuttings lightly hold each stem about one third from the base and quickly pull it through finger and thumb. Pinch out the tips of all cuttings (see inset)



5 full cells or pots with a mixture of equal parts moist leaf mold and peat, or equal parts fine bark and peat. Insert the cuttings so that the lowest leaves are just resting on the surface. Do not firm in the cuttings

Open year every day, if needed



6 Water in the cuttings with a general purpose fungicide, using a watering can with a fine rose. Label the cuttings, then place them in a closed case - a heated one speeds rooting. Allow to root in a place out of direct sunlight.

#### GROWING ON SEMI-RIPE CUTTINGS

Prochamics bushiness



The cuttings should root after 8-12 weeks to keep them growing vigorously, began feeding them regularly once a week with a low nitrogen fertil zer such as for tomatoes. Punch out the growing tips regularly to encourage formation of bushy new growth.

#### LAYERING

In the wild, sandy soil drifts over heaths and heathers, which then root readily from the stems, so layering these plants is even easier than cuttings. Layered plants are not always as uniformly bushy as plants grown from cuttings, however

Mix in a little sharp sand and pear into the soil in a shallow trench around the parent plant to provide a good well-drained rooting medium. In early to midautumn or spring, bend down healthy, strong sideshoots and cover with a little of the prepared soil. Peg down the shoots with wire staples or weigh them down with small stones. There is no need to cut or wound the stems. One year later, cut off the rooted stems, grow on in a nursery bed or in pots for six months before planting out.

If only one or two rooted lavers are required, simply prepare the soil beneath the chosen shoots (see right)

Alternatively, to layer a large number of shoots, lift the plant in midspring, dig out the hole, and replant, leaving one-third of the shoots exposed. This type of ayering is "dropping" (see right)

Fill in between the shoots as shown Other options, which make it easier to weed around the plant if the shoots are lew, is to arrange them into a row or, if the shoots are not brittle, to press them around the edge of the hole to form a circle. Firm the soil to encourage the shoots to root into it

Keep the plant well watered until autumn. Clear away the soil and remove the rooted cuttings, cutting just below the new roots on each stem. Discard the old plant. Pot the rooted layers and grow on as for cuttings (see above)

#### SOWING SEEDS

Raise species such as Erica terminalis and Calluna vulgaris from seeds. Sow in winter to early spring as for rhododendrons (see p. 138). Epacris germinates better if treated with smoke (see p. 103).



2 year 4-6 months, when the plants are well developed pot them individually into 3in 5 m) pois of soilless potting mex, using an acidic formula for time having heathers. Grown outdoors, protecting from severe cold if needed to prevent young shoots from dying back



3 From late summer anward plant out the heaths and heathers in their final positions for the best effect, plant them in irregalia groups, spacing them B-10m (20-25cm) apart. They should rapidly grow into one another to form large champs.

#### LAYERING



In spring, select a nealthy shoot from around the edge of the plant. Work a little leaf mold or peat and grit or course sand into the sell-below if e shoot to promot aroungs.

there the shoot in the prepared area of soil and place a stone sort to keep it a prace. The following spring, life the rooted layer sever from the parent, and plant out

#### DROPPING HEATHERS

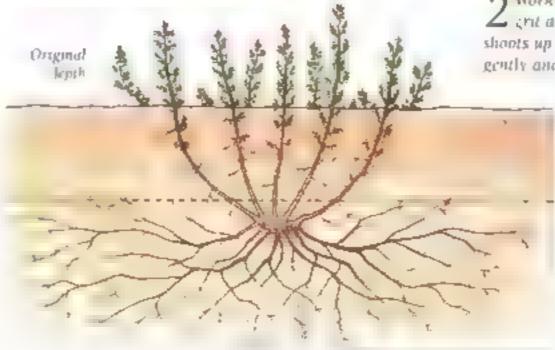


In spring, lift a mature plant. Dig a hole deep enough a two thirds bury as plant into the hole and full in with soil around the roots.



2 Work a mixture of equal parts

2 grit and peat between the
shoots up to soil level. Firm in
gently and label.



3 water the plant during dry spells By autions, the buried sections of the stems should have formed roots. Lift the whole plant and sever the rooted shoots from the parent plant. Pot them singly to grow on or plant them out in a sheuered spot.

## ROSES

Contrary to common belief, all roses, whether species roses, old garden roses, or modern cultivars, are easily increased, even by gardeners with only limited space

Roses are propagated in basically three ways. Cuttings are easiest for the gardener, although they are not recommended for producing high-quality plants from most modern hybrid tea or floribunda roses. Grafting or I budding roses, methods favored by commercial growers, require some planning and rootstocks that have been grown on in advance, but they usually produce more vigorous plants

Raising roses from seeds can be challenging and is usually most rehable with species roses. However, the rose is a classic cand date for hybridization and some amateur rose growers have produced worthwhile cultivars

### TAKING CUTTINGS

Hardwood cuttings are most successful from miniature, groundcover, and species roses, as well as some older Rosa wichurana (syn. R. wichuraiana) ramblers, they are taken in much the same way as for other shrubs (see p. 100).

Although a controlled environment and a little care are required, increasing roses from softwood cuttings has proved very effective for some of the more difficult species and cultivars such as R bankstae and R. 'Mermaid', as well as for mass-production of pot roses

HARDWOOD CUTTINGS OF ROSES
First prepare a slit trench in semi-shade, about 8in (20cm) deep, and sprinkle some sharp sand along the bottom to

#### HARDWOOD CUTTINGS



SELECTING SUITABLE STEMS. In late summer or autumn, take well-ripened, healthy, woods shoots from the current season's growth, approximately 12–24 in (30–60cm) long

ROOTED CUTTING By
the following spring, the
cuttings should start to
root and produce new shoots
in the following autumn, lift
each rooted cutting (left) with
a hand fork, taking care not to
damage the roots. Plant the new
tose in its permanent position

One year-old
witing.

Strong new mots

improve the drainage. Gather suitable shoots (see above), cutting each at an angle just above an outward-facing bud. Place the shoots in damp newspaper or moss to prevent them from drying out before they can be prepared. Divide the stems into 9in (23cm) lengths, removing all but the top two leaves and cutting through a bud at the base of each cutting. There is no need to leave a heel

Dip the base of the cuttings first in water, then in hormone rooting powder, and place in the trench 4-6in (10-15cm) apart. Fill in the trench and hill it up so that the leaves are at soil level. Firm and water in well. In dry conditions, protect the cuttings with a black plastic mulch. Rooted cuttings may be planted out in a year (see above)

Quicker results may be obtained by rooting 3in (8cm) cuttings in rooting medium in 3in (8cm) pots under cover, supplying bottom heat of approximately 21°C (70°F) in a closed case or on a propagating blanket (see p 41). The rooted cuttings should be ready for planting out by the following spring This works particularly well for most groundcover and miniature roses

Softwood cuttings of Roses
Cuttings should be taken from plants
that have been encouraged to produce
young wood by pruning them hard in
early spring, preferably in a protected
environment such as a greenhouse. The
first new shoots from garden plants may
also be used as cuttings, if they have not

#### TAKING SOFTWOOD CUTTINGS OF ROSES



In early to midsummer, choose healths
shoots (here of Ross banksise) of the current
scason's growth. Remove each by cutting just
above a node with pruners. Immediately place
the cuttings in a plastic bug to keep them fresh



2 Cut each shoot into sections, cutting above each node along the stem, so that each internodal cutting retains one leaf at the top Discard the growing tip: it is too soft to root frim the leaflets to reduce moisture loss



3 Immerse each cutting in fungicidal solution. then dip its base in hormone moting powder. Insert the cuttings in 1 in (2.5cm) deep holes in large plugs of mediwool, or space them 2 in (5cm) apart in seed soil mix in deep seed trays. been exposed to herbicides. This simple technique does not work for hybrid teas and grandifloras, however

Early to midspring is the best time to take softwood stem-tip cuttings, when new shoots are only 1 /-2in (4-5cm) long and need no trimming. Internodal stem cuttings from longer soft shoots may be taken in summer (see facing page). Treat all cuttings with systemic fungicide to prevent rot and hormone rooting compound to aid rooting. When inserting the cuttings into the medium of rockwool, ensure they do not touch

Maintain high humidity around the cuttings by tenting them in a plastic bag or placing them in a closed case or mist unit (see p.44). Provide bottom heat of about 81°F (27°C) at first, then after four weeks or so, reduce it to 64–70°F (18–21°C). Harden off the rooted cuttings by gradually reducing the time they are covered. Pot them singly into 3in (8cm) pots in a soilless mix

A reasonably sized plant can be produced in this way in two months or so Cut back the young plants by about 50 percent to ensure bushy growth. The prunings provide very good material for further propagation – this is a common practice in commercial nurseries

### DIVIDING ROSE SUCKERS

Some roses, particularly rugosas and the Scotch rose (R. pimpinellifolia) cultivars, are often grown from hardwood cuttings on their own roots, rather than grafted onto different rootstocks. Suckers, freely produced by these roses, are therefore true to type and can be removed and planted out. This is particularly useful if many plants are desired, perhaps for a hedge. Lift suckers when not in active growth with a reasonable length of root (see below), and replant immediately

#### DIVIDING A ROSE SUCKER



In late autumn or early spring, select a welldeveloped sucker and, using priners, sever it from the rootstock, retaining as many roots as possible. Prepare a hole wide and deep enough for the roots. Plant immediately, water, and firm

### GRAFTING

Standard grafting and
T-budding (see pp. 114–15)
involve uniting material
from two different roses to
combine the virtues of both
A scion or bud from the topgrowth
of the rose to be propagated is united
with a rootstock selected for its vigor
and hardiness. Grafting roses requires a

warm, humid environment under cover but allows large quantities of new plants to be produced in the same growing season. Budding is done in the open garden, but it takes much longer

#### **GRAFTING ROSES**

Grafting is most appropriate for miniature roses and some groundcover kinds; it is used extensively to produce plants for the cut-flower industry

Conventional seedling rootstocks, such as R. laxa or R. chinensis 'Major', are used for commercial grafting and may be obtainable by the gardener from specialized nurseries. They are graded according to the diameter of the stem, or "neck", roughly %—%in or %—%in (5—8mm or 8—12mm)

The rootstocks are brought into the greenhouse early in the year, and must be heeled in into a 7in (18cm) deep peat bed, supplied with bottom heat of 64°F (18°C) to encourage growth

The type of graft used is similar to that used to rind graft fruit trees (see p 63). Take semi-ripe shoots as they develop in spring for use as scions. Cut the shoots into short lengths, each with a bud and one leaf (see above). Trim the base of each stem into a wedge by removing a sliver from one side of the stem. Lift the rootstocks, then remove the topgrowth with a straight cut at the top of each "neck" just below the

HOW TO PROPAGATE EACH TYPE OF ROSE

Hybrid Tea (Large-Flowered Blsm) Roses
Grafting, T-budding, hybridizing
Floribl Noa (Cluster Flowered Blsm) Roses
Grafting, T-budding, hybridizing
Miniatere roses. Hardwood and softwood
cuttings, grafting for container-grown
plants, T-budding, hybridizing
Groundcover roses. Hardwood cuttings,
grafting, T-budding, hybridizing
Climbing and Rambler roses. Hardwood
cuttings for some of the older Rosa
withingare ramblers, softwood cuttings for
difficult subjects such as Rosa banksiae
cultivars and Rosa 'Mermaid', T-budding
hybridizing

Modern status roses. Hardwood cuttings. T-budding, hybridizing. OLD GARDEN ROSES. Hardwood cuttings. division, T-budding.



I Select a semi-ripe shoot of the current season's growth. Take a stem cutting with one leaf stalk. Make an angied cut above the top node and cut the bottom time (2.5cm) of the stem to a we lee shape.

Cut exposes cambinan



Bud at

feat aid.

One leaf remains

toxer se ou se a almunto-es osward

Vertical cut

2 Cut straight across the top of the "neck" of the rootstock, using pruners. From the top, make a vertical cut in the bark. Im (2 5cm) in length, and gently open up the bark flaps. Slide the scion into the cut and bind securely

branches. Shi the bark, insert a prepared scion under the flaps (see above), and secure with thin thread or grafting tape

Pot each grafted rootstock in seed soil mix and place in a closed case or mist unit at a temperature of 59–75°F (15–24°C). Leave for about four weeks until the graft calluses and the seion begins to grow. Pot on into 5in (13cm) pot. Harden off over six weeks, then plant in final positions in late spring

SPECIES RUSES Hardwood cuttings, division, 1 budding, seeds



HIPS OF ROSA FRU DAGMAR HASTRUP

#### T-BUDDING ROSES

Until the advent of hybrid tea (large-flowered bush) roses, all roses were grown from cuttings. As breeding progressed, many cultivars lost the ability to develop a satisfactory root system. Budding onto a more vigorous rootstock had long been used for other plants, and by the mid-nineteenth century it was adopted as the principal method of propagation for all types of rose in commercial nursenes. Although slow and a little more challenging for the gardener, it is still the best way of producing high-quality plants from garden cultivars

Stocks for budding roses may be available during writer from specialized nurseries. They are graded according to the "neck" size, roughly %—%in or %—½in (5–8mm or 8–12mm), and various stocks are available in different regions (see box, right), but most are compatible with any cultivar. If the soil is frozen or too wet, the stocks should be heeled in until they can be planted in early spring. The planting site should be weed-free and prepared well beforehand by digging in compost or well-rotted manure.

Commercial growers plant stocks Bin (20cm) apart in rows 3ft (90cm) apart Small quantities may be planted singly

in holes made with a stick or in a shit trench (see below). If they are not already trimmed, cut back the topgrowth to 9in (23cm) and the roots to 6in (15cm). The neck should be covered with soil up to but not above, the branches to keep the back moist and supple at the point where the bud is to be inserted. Firm the soil well. Water only in very dry conditions and control weeds to prevent competition Budwood for use in budding is taken

#### SEED-RAISED ROOTSTOCKS

ROSA LAXA Popular stock, universally produces high-quality plants, almost free from suckers. Tends to go dry (reduced sap flow) in midsummer thus early building is essential. Rust disease was a problem but is now easily controlled with suitable rose fungicide. Principal stock available to gardeners in UK.

R CANDA TNIBMS' Almost as popular as R Itom, particularly in Mediteroment are as R DR HUEY Popular stock tu son tiern California. Arizonal and southeastern Vistralia tolerates dry alka me soils before stava. Deep rooted rose good for sandy soils in warm clanares, so was Western Australia.

from the roses to be propagated at the beginning of the summer, after the stems have ripened, or hardened, and have begun to flower. A good test of whether the wood is ready is to break off some thorns, with the majority of cultivars they should come away cleanly.

Gather the budsticks (see below right) and store in damp moss or newspaper in a cool place until needed, labeling them carefully. Never stand them in water

#### ROOTSTOCKS GROWN FROM CUTTINGS

R MITOTORA Roots very easily in warm chinates can be T budded eight weeks after tooting. Common in easiern Australia and New Zealand, Good for weeping forms. R. CANNA earlivers.

R DR BUD

R client via Major Used widely in but chinates, tolerates dry, abrahne sons Rootstocks for standard roses

R cannot (Wild dog rose) Traditional stock

R MITHTORA R POIMERANA R R YOLSA

Local advice on the most statable stocks may be obtained from any large rose mosery

### I-BUDDING: PLANTING THE ROOTSTOCK



I in early spring, the a V-shaped torneh with a spade, deep enough for the mots of the motstock (here Rosa laxa) to be accommodated. Place the stock in the trench.



2 Fill in the trench and from in the soil gently, then hill up around the neck of the stock as far as the base of the branches. Label and water in soil

#### T-BUDDING: PRI PARING THE BUDSTICK



In early summer cut off lengths of vigorous, repening, flowering shoots, about 12m (10cm) long Make an angled cut at the base of cach shoot just above a bud



2 Remove the soft topgrowth and leaves from each budstalk Cut each leaf stalk about van Sunn) from the stem to leave a broudic Label and weep moist

#### I-BUDDING: PREPARING THE ROOTSTOCK



In midsammer uncover the 'neck" of the rootstock by gently easing the soil away with a hand tork. This should be done just before preparing the bad, so that the neck of the stock does not dry out.



2 Clean the back of the stem 2 gently using a soft, dry cloth This will remove any soil or grit which could blant the blade of the building knife



3 Make a 'sin (5mm) how gortal
cut into the bark about Im
,2 5cm) below the topgrowth.
Then make a vertical cut upward
to join the how contal cut so that
they form a T-shaped incision



4 Using the reverse plade in one knife gently pry open the flaps of bark created by the two curs. The thin, green cambium will be reveated underneath. The stock is now ready to receive the bua.

#### I-BUDDING: PREPARING THE BUD



Hard a badstick so that the 1 buds point upward. Snap off the thorns from the stick, making sunthat no snags remain



msert the knife about on 4 5mm) away from a leaf stalk With a straight, scooping action, cut out the stalk and the bud, together with a fin (2 5cm) long "tail "



Hold the bud by its tail and peel away the wood from the green bark Discard the wood. Trim off the fail (see inset) to leave a scion that is about 3in (fro ) long



By DYTHER MATERIAL Fach stage in the preparation of the bud or soon proobers discardary different parts of the budstick (see above

#### T-BUDDING: UNITING THE GRAFT



Senial

Feat m stault Leid stulk

Cormant bud faces agree and Flaps of back

1 Hold the scion by the leaf stack and stip-I the tapered end under the back flaps in the rootstock, see above self). Sit the first is atlyunder the flaps, if needed term the scion are ss the top so it fits in the T-cut (see above right



To ensure close contact between the scion. and stock, secure a rubber grafting patch see insert an include graft proming it on the viac - prosite the bird. As the stock heals or c calluses over, the rubber patch will rot off



THE FOLLOWING STRING. In early spring cut off the top of the stock with printers, just above he dormant bud. For a stronger, midtistempted plant, cut back the shoot emerging from the had so susset) to the Bein) or more to late spring

### T-BUDDING ONTO A STANDARD ROOTSTOCK



USING MELTIPLE B) DS busert two or three buds, Jin (8cm) apart, around the stock stem at a height of 3%-4/r (1.1-1.2m) from the ground. Secure each with a rubber patch



CUTTING BACK IN SPRING In spring, cut back the stock just above the new shoots that are developing from the grafted bads

they will rot at the base. Budsticks may be kept until midsummer, which is the most suitable time for budding. In warm climates, buds taken in late summer should shoot in the following spring

Newcomers to budding should get in plenty of practice at cutting, using young willow sticks, before attempting to bud the roses. The actual process should be carried out quickly to prevent the bud or neck from drying our

When ready for budding, remove the soil from around the stock stem. Prepare the neck to receive the bud by making a T-shaped cut in the bank (see facing page) Cut out a bud on a shield-shaped sliver of bark from a budstick and then remove the wood (see top); the prepared bud is known as the scion. Insert the scion into the T-cut and secure with a budding patch (see above)

The graft should heal in 3-4 weeks In cold climates, the rootstock should be hilled up for the winter to protect it, but this is not necessary in milder chimates. If it has been hilled up, uncover the budded stock in early spring. Cut back the stock to just above the dormant bud using very sharp pruners. As the season

progresses, the bud should begin to grow. It is a good idea to prune back the new shoot (see above) to encourage a bushy plant. If a vigorous climber has been budded, it will need staking as it develops. By early autumn, the rose will mature sufficiently to transplant to its permanent position

#### T-BUDDING STANDARD ROSES

The method of budding is the same as for bush roses, but usually two or three buds are inserted around the stem to obtain a balanced head (see left). The height of the buds above soil level determines the type of standard. 2lt (60cm) produces a half standard, 3ft (90cm) gives a full standard; 4ft (1 2m) yields a shrub or weeping standard

In theory, all roses can be grown as standard plants, but many will look ugly simply because of their upright habit The best results can be obtained from cultivars of miniature and floribunda roses, groundcover roses, some laxgrowing shrub roses, and the older wichurana ramblers that will grow into weeping standards. Standard stems require staking to avoid wind damage

### ROSES FROM SEEDS

All species or wild roses can be grown from seeds to obtain seedlings identical to their parents. The greatest problem is germinating the seeds, which can take as long as two seasons. In order to overcome their dormancy, the seeds need to be stratified or chilled before sowing (see p 103). Rosehips ripen in mid- to late autumn; many cultivar hips are green when ripe, not red like those of species. Seeds may be strainfied before or after extracting them from the hips

Seeds extracted from freshly collected hips (see right) should be placed either in a plastic bag or in a seed tray in moist peat, vermiculate, or sand. Label and keep the seeds at about 70°F (21°C) until late winter, then chill the seeds by placing the bag or tray in the refrigerator at just above freezing (35°F/2°C) for 3–4 weeks

The seeds can then be sown in cells (see right) and left in a cool, sheltered place such as a cold frame. They may take a year to germinate. Pot the seedlings when they have their first true leaves, then grow on until they are established. Harden off the seedlings (see p.45), and pot on as necessary until they are large enough to be planted out.

In cold climates, the hips may be agreed 2in (5cm) deep in a container in moist peat, vermiculite, or coarse sand and left outdoors for 12–15 months in a cool, shady place. This allows the seedcoats to break down naturally. In the early spring of the second year, remove and clean the stratified seeds (see above), then sow them in an outdoor seedbed. Prepare the seedbed with 4in (10cm) of a soil-based seed mix.

Sow the seeds 1-2in (2.5-5cm) apart and cover them with Ain (1cm) of seed soil mix or fine soil and Ain (1cm) of fine gravel. Germination can take as long as two months. Transplant the

#### GROWING SPECIES ROSES FROM SEEDS



In autumn, cut open a tipe hip taken from the parent plant with a clean, sharp buth t se the reverse of the hinfe blade to flick out the individual seeds



3 hill a cell tray with a mix of one part sand to one part peat substitute (or peat). Sow the seeds singly and cover to their own depth with grit. Label. Place in a cold frame.

seedling roses into a nursery bed in the following autumn and plant them out in the garden 2-3 years later

#### HYBRIDIZING ROSES

The production of new cultivars by crossing two different roses and then selecting the best of the seedlings is a time-consuming, but exciting, exercise for commercial growers; it is also enjoyed by many home gardeners

Expert breeders consider the parents' chromosomal makeup and employ a strategy of using genes in the parents, not necessarily commercial cultivars, which have been selected for their



2 Put the seeds into a clear plastic bug containing peat and keep it at about 70°F (21°C) for 2–3 months. Then place the bug in a refrigerator for 3–4 weeks



Aware the scralings have their first pairs of true teases transplant them singly into 20 (5cm) pots filled with a soil based potting mix Put the pots back into the cold frame

desirable features. For the first-time hybridizer, it is more practical to use as parents modern cultivars that are fertile and are known to yield a good harvest of hips. Select roses whose characteristics you wish to perpetuate, such as disease resistance, habit, flower form, scent, or color. In practice, two popular named cultivars, when crossed, will rarely produce anything of commercial significance.

Many species crossed with a cultivar will produce sterile progeny. If a repeat-flowering, or remontant, rose is crossed with a nonremontant rose, it will probably yield nonremontant seedlings.

### HYBRIDIZING: PREPARING THE POLLEN PARENT



2 Once the flower 2 is fully open and the anthers have split to reveal the pollen (usually after 24 hours), gently pull off all the flower petals. The anthers should be left intact.

3 The exposed anthers are now ready to release their pollen Brush a clean camel hair brush over the anthers to collect the pollen

#### STORING ROSE POLLEN



Anthers may be gathered up to one month before hybridizing and stored in a clean dish. When ripe, the polien looks fluffy.

#### HYBRIDIZING: PREPARING THE SEED PARENT



1 Choose a healthy flower that is not fully open and not yet pollinated on the seed parent



2 Pull off the petals with a quick twist working inward to reveal the immature authors



3 Carefully pluck out the anthers
with tweezers. Do not damage
the stigorax Leave for 24-48 hours



4 Transfer the rape pollen onto the now sticky stigmas using a camel hair brush or a clean larger

free place



5 Label the pollunated flower with the name of the pollen parent and allow to repen towers on the same seed parent may be tertaized with pollen from different reses



HYBRIDIZED

SEEDLINGS

Rase seedings grown

from hybrich, ca seeds

should be raised to

flowering size in a

nursery bed in a cool

greenhouse or frost

A selection can
then be made based
on foliage and flower
cotor. This can vary
enormously among
seedlings from the
same parents (see
left). Many will be
pink or vermilton.

The best results in hybridizing roses are achieved in a controlled environment free from insect pollinators. A well-ventilated greenhouse is ideal, but an elaborate heating system is not needed except in very cold climates. A large greenhouse also provides more even temperatures. Hygiene is of greater importance, and in early autumn the greenhouse must be thoroughly washed down and disinfected (see p. 38). Allow sufficient time for the greenhouse to air and dry out before bringing in plants

Of the two roses selected for hybridizing, one acts as a pollen (male) parent, providing ripe pollen, and one as the seed (female) parent, producing hips and seeds. Many-petaled roses do not produce much pollen, while some roses may not form well-developed hips. Weather also exerts an influence

Pot the chosen parents in rich potting mix in large containers and leave putdoors in early autumn. Bring into the greenhouse in midwinter at a minimum of 40°F (4.5°C), where they can develop Prune bush roses lightly after a month inside. On sunny days provide good ventilation and water lightly, but do not leed them. By midspring, young shoots should be developing.

#### POLLINATING THE SEED PARENT

Prepare the pollen parent first (see facing page) to gather the pollen: ripe pollen looks floury or fluffy in texture. Pollen can be gathered up to a month before the seed parent is ready if necessary, but it must be kept very dry

The flower of the seed parent must be well developed but not fully open the anthers will still be immature and will not yet have pollinated the flower Remove the petals and anthers of the seed parent (see above), making sure that no fragments are left, because these may allow rot lungs to attack the plant Within 24-48 hours, the stigmas will be ripe and sticky and ready to receive pollen from the male flower. Once it is pollinated, label the seed parent with the names of both parents. If using pollen from different parents for different flowers, clean the brush thoroughly between applications

If successful, the hip should develop and ripen by midautumn. Remove any new buds or shoots as they appear, keep watering to a minimum, and do not feed the rose to keep new growth to a minimum. Do, however, provide ample ventilation. If the pollination was unsuccessful, the hip will rot or shrivel

#### CARE OF HYBR DIZED SEEDLINGS

In autumn, extract and stratify seeds in sand from successful hips, as for species roses (see facing page). Sow the seeds in a prepared seedbed under cover, such as in a cool greenhouse. Water as required, but avoid excessive watering. Rose seedlings can sometimes be subject to dieback or rot, usually as a result of overwatering or extreme temperatures. Strict hygiene, using a complete rose fungicide, is the only answer.

Expect to see germination within two months and growth of 9–18in (23–45cm) in the first year, when most of the new plants will bear small blooms Since the parentage is known, the color and form of the blooms will provide clues to the eventual plant. A lack of blooms indicates that the seedlings are only summer-flowering; select more reliable repeat-blooming parents next time

In midsummer, choose the best three or four seedlings and T-bud them onto rootstocks outdoors (see p.114). In the following year, the full results of the hybridization will become evident. The hybridizer should build up a stock of the most promising cultivars throughout the following seasons, disposing of the less choice hybrids along the way

# A-Z OF SHRUBS AND CLIMBING PLANTS

### ABELIA

SOFTWOOD CUTTINGS in spring I
GREENWOOD CUTTINGS from late spring I
SEMI-RIPE CUTTINGS from early to late summer II

Cuttings of these deciduous and evergreen shrubs root very readily in a closed case or mist bench. Softwood cuttings (see p 100) from the first flush of growth root in 2-4 weeks. In colder regions, do not pot greenwood cuttings (see p 101) taken after midsummer; prune cuttings for a bushy habit, but allow new growth time to ripen – if not well established, they overwinter badly Keep semi-ripe cuttings (see p 95) taken in late summer frost-free. Plants flower in 1-2 years

### ALLAMANDA



Alkamanda Lurharrica

CUTTINGS throughout summer & Division in spring &

The evergreen shrubs and scrambling climbers in this genus root readily from greenwood nodal stem cuttings (see p 101)

Take 2-3in (5-8cm) cuttings and root in humidity with bottom heat of 59°F (15°C). Cuttings should root in 6-8 weeks and flower in 2-3 years.

Alternatively, for instant new plants, divide clumps of mature specimens (see p 101), cut back hard, and replant

## AMELANCHIER

JUNEBERRY, SHADBUSH

CUTTINGS in late spring 11
DAVISION in early spring 1
SEEOS in autumn or spring 1
LAYERING at any time 1

Many shrubby species in this genus produce suckers and are easily divided. They also hybridize readily, so seeds may not come true. New plants flower in 2–3 years.

#### CUTTINGS

For best results, take softwood cuttings (see p 100) once the new growth is no more than 4m (10cm) long

#### DIVISION

Divide clump-forming species (see p 101); lift and replant rooted suckers (see p 101) of Amelanchier canadensis

#### SEEDS

Gather seeds from ripe, black fruits and sow fresh in summer or autumn (see p 103). If stored, dry seeds have hard coats, sow in spring (see p 104) to germinate the next spring, or, before sowing, warm and then cold stratify (see p 103) the seeds to hasten germination

#### LAYERING

The technique of simple layering (see p 106) is effective for all species in this genus, especially A, lamarchit

## ABUTILON FLOWERING MAPLE, INDIAN MALLOW, PARLOR MAPLE

SOFTWOOD, GREENWOOD AND SEMI-RIPE CUTTINGS at any time 1.
HARDWOOD OUTTINGS in accomm 12.

Seeos in early spring t

Most of the evergreen and de

Most of the evergreen and deciduous flowering shrubs in this genus can be increased from soft- or greenwood cuttings (see pp 100–101) at any time If using the cuttings for summer bedding, take them as nodal stem-tip cuttings in late summer Root as for Abelia (see above), pot, and provide a

minimum winter temperature of 41°F (5°C). For Abutilon megapotamicum, A pictum 'Thompsonii', and their related cultivars, use semi-ripe stem cuttings (see p.95). Hardwood cuttings (see p.98) of both A. x suntense and A. vitifolium root well, keep them frost-free

Sow seeds (see pp 103-4), gathered from dry seedpods. Germination is rapid under cover, but watch for whitefly and spider mite (see p 47). It usually takes two years for new plants to flower

### ACTINIDIA KIWI FRUIT, CHINESE GOOSEBERRY, SILVER VINE

GREENWOOD OR SEMI-RIPE CUTTINGS IN CAPA-

HARDWOOD CUTTINGS in late statumen to misdwanter |
SEEDS in spring of autumn |
LAYERING | Processor |
GRAFTING | Processor | Control |

Cuttings are the easiest way to increase most of these mainly deciduous climbers Greenwood is best for Actinidia deliciosa (syn. A chinensis) and A. kolomikta; semi-ripe or hardwood for A arguta; hardwood for A deliciosa. Seed-raised species grow rapidly. New plants flower and fruit in 2–3 years

#### CUTTINGS

For greenwood cuttings (see p.101), use hormone rooting compound and reduce A deliciosa leaves to 2in (5cm). Take shoots for semi-ripe and hardwood cuttings (see p.95 and p.98) that are not too vigorous and prone to rot.

#### SEEDS

A male and female plant are needed for fruits (see right). Seeds germinate at once if sown fresh, spring sowings need a three-month cold period (see p. 103).

#### LAYERING

If only one or two plants are needed, simple layering (see p. 106) works well for all forms.

#### GRAFTING

For named cultivars, use a whip-andtongue graft with seedling rootstocks (see p.59) Grafted plants tend to be more vigorous than cultings.



Extracting Actinible Speeds from fruits blice a tipe from (here of A. deliciosa) in half blick out the seeds with the tip of a knife Place the seeds into a fine-meshed sieve and wash off the pulp under running water before drying and storing the seeds. Alternatively, sow seeds fresh in a container without washing them

### AUCUBA JAPANESE LAUREL

CUTTINGS from late statuter |
SEEOS in automn |
LAYERING in spring and automn |

Of these evergreen shrubs, only Aucuba japonica is commonly grown. Semiripe cuttings can be easily rooted in a sheltered nursery bed, such as in a cold frame (see p 95) If preferred, reduce the foliage for ease of handling, bottom heat at 70°F (21°C) speeds rooting, in 6–8 weeks. Leave the cuttings until spring before potting. New plants mature in 3–4 years

Gather seeds from ripe berries (see below), sow fresh in autumn (see p 103). Germination may take 18 months

Simple layering (see p 106) works well, layers can be planted out in 12 months

At CUBA BURRIES
Rub the berries in a rough
cloth to remove the flesh
from the large seeds



### BERBERIS BARBERRY

SEMI-RIPE CUTTINGS from midsummer 11 MALLET CUTTINGS in early summer or autumn 11 HARDWOOD CLITTINGS Its movage autumn to midwinter II

DIVISION at any time | SEEDS in late winter or early spring [ GRAFTING in late winter I

These are deciduous and evergreen, thorny shrubs. Cuttings can be tricky. so divide mound-forming species or graft less ready-rooting cultivars. New plants usually take at least two years to flower

Cuttings from semi-npe wood (see p 95) root most quickly, especially in rockwool plugs (see p 35) Mallet cuttings (see below) are best for Berberis x tologensis and its cultivars. Both types

respond to hormone rooting compound. Protect semi-npe and evergreen frame or clocke in colder chmates.

B. bioxfolia can be divided (see p 101) in any season, but spring and autumn division gives the best results.

Seeds gathered from ripe fruits need a short period of chilling to break their dormancy. Layer the berries in sand (see p 103), or sow outside or in pots (see p.104) to germinate by summer

Propagate B. x lologensis, B. linearifolia, and their cultivars by spliced side grafts. (see p.109) onto cutting-raised, one-yearold rootstocks of B x ottawensis.

hardwood cuttings (see p. 99) with a cold Mound-forming species such as

Bougamvillea glabra "Variegata" SOFTWOOD OR SEMI-RIPE CLETTINGS in summer II HARDWOOD CUTTINGS IP winter 11 LAYERING in late winter and carly spring 1

Layering is usually a more effective method than cultings in colder climates for propagating the deciduous and evergreen, scrambling climbers in

this genus. New plants generally flower in 2-3 years.

BOUGAINVILLEA

#### CUTTINGS

Softwood or semi-ripe cuttings (see pp. 100 and 95), 2-3in (5-8cm) long, taken with a heel or a piece of last year's growth (see p 96), will root in 4-6 weeks if kept humid Bottom heat of 59°F (15°C) speeds the process.

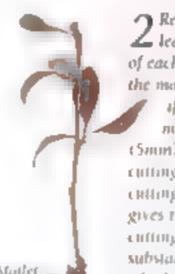
Root hardwood cuttings (see p.98) in deep pois on a heated bench at 70°F (21°C) in colder climates. In warm, humid climates they may be rooted outdoors; they take up to three months to root but form sturdy plants.

#### LAYERING

Use either simple or serpentine layering (see pp. 106-7), container-grown plants may be layered into pots and separated

#### TAKING MALLET CUTTINGS

1 take mallet Leatings from last year's stems, Di early summer for decidaous species or databilit for evergreens. Choose short sideshoots, about fin (10cm) long, of the current seasons grawth. Cut just above and below the post in the main stem to leave a 5m (1cm). section (malter) at the base of each cutting



Remove the lower. leaves and soft tip. of each sideshoot. Shi the mallet lengthwise if its diameter is more than san-(5mm) Then treat the cuttings as semi-ripe cuttings. This method gives thin stemmed enflorgs a more substantial base from which to produce mors

#### OTHER SHRUBS AND CLIMBING PLANTS

Sale sheet

ABL TOPPING CM. Take softwood to semi-ripe cultings (see pp. 100-101 and 95) [ Simple laver in spring (see p 106) 4. Sow seeds in butiann (sec p 104) 1 Acacta Take sems-ripe cuttings (see p 95) 11. Soak seeds in hot water (see p. 10.1); sow in spring at 70-77°F (21-25°C) 1. ACALYPHA Root softwood or stem-tip cuttings (see p 100-01) at 70-81°F (21-27°C) 1. Divide clumps (see p 101) in spring [ ACEA Root semi-ripe cuttings (see p. 95) in a frost-free place or under protection with bottom heat [1]. Sow seeds as for Fatsta (see p. 128) 1. Acsoulus Sow fresh seeds outside in autumn (see p 103) 1 Divide suckers (see p 101) 1 AKEBIA Take greenwood cuttings (see p. 101) in late spring to midsummer 11. Sow seeds in spring after a short period of cold stratification (see pp. 10.3-4). 5- Serpentine layering (see p. 107). gives best results 1. ALOYSIA Take spitwood to semiripe cuttings from spring to

midsummer as for Caryopteris (see p.121) L. Arrogaste Root semi-ripe cuttings (see p 95) with genile bottom heat 4. Sow seeds in spring (see p. 104) 4 AMPLIOPSIS. Take softwood to: greenwood cuttings as for Parthenocissus (see p.136) L. Sow seeds in autunin (see p. 103) L APHELANDRA Take greenwood cuttings (see p.101); use 68-77°F (20-25°C) bottom heat L. ARALIA Take root cuttings of species as for Celastrus (see p 122) 11. Divide suckers as for Amelanchier (see p.118) 14. Sow fresh seeds in autumn (see p. 10.1) 44. Spliced side graft variegated forms (see p 109) 11. ARCTOSTAPHYLOS Take semi-ripe cuttings (see p 95) in aurumn 44. Soak seeds in hot water sow in autumn (see pp 103-4) [[ ARDIMA Take softwood to semiripe cuttings in summer as for Hibiscus rosa-sinensis (see p. 131) 11. Sow seeds as for Passiflora (see p. 136) 11. ARGYRANTHEMUM Take softwood

to senti-ripe, nodal stem tip. cuttings (see pp 101 and 95) § ARISTOTOCHIA Take softwood cuttings (see p 100) of tender species in spring, for hardter ones, take greenwood cuttings (see p 101) until midsommer & Sow seeds in spring (see p 104) L ARONA Root softwood to greenwood cuttings in early summer (see pp 100-01) [. Divide suckers (see p 101) in late winter & Sow seeds in autumn (see p. 103) & ARTEMISTA Insert greenwood stem-up cuttings (see p. 101) in spring in a freedraining medium under plastic & Take semi-ripe stem-tip cuttings as for Phlomis (see p 137) 4. ASIMINA Take root cuttings in winter as for Celastries (see p.122) II. Sow seeds in autumn (see p. 103) 🚻 Banksia Root semi-ripe stemtip cuttings (see p. 101) in late. summer in rockwool plugs or free-draining medium 🚻

Space-sow seeds in spring after

gaving smoke freatment (see pp 103-4) [1 BADERA Root senti ripe cuttings. (see p 95) in midsimmer in a free-draining medium J. Sow seeds in spring (see p. 104) at 68-77°F (20-25°C) L BORONIA Root semi-ripe cuttings as for Phlomis (see p.137) 11. Sow seeds in spring (see p. 104) and keep them cool []. BRACKENTHALIA Take greenwood

cuttings as for evergreen azaleas (see Rhododendron p 138) 1. Sow seeds as for Rhododendron (see p. 138) 1. BRUGMANSIA Root softwood to semi-ripe cuttings (see pp 100-01 and 9.5) in spring and summer in a free-draining medium or rockwool plugs L. Sow seeds in spring (see p. 104) at 68-77°F (20-25°C) L Br. MFELSIA Take softwood and greenwood cutungs (see pp 100-01) in spring and summer 1.

BANKSIA ATTENLATA

### BUDDLEJA BUTTERFLY BUSH, BUDDLEIA



Buddieta davido Empire Blue

SOFTWOOD OR GREENWOOD CUTTINGS in spring and summer 1 SEMI-RIPE CUTTINGS From midsummer 1 HARDWOOD CUTTINGS from autuinn to midwinter SEEDS in spring |

The shrubs in this genus root readily from softwood and greenwood nodal stem-tip or internodal cuttings (see pp 100-01) and from semi-ripe cuttings (see p 95) Reduce foliage by half on Buddleja davidu cultivars. With B. globosa, avoid material affected by leaf and bud nematodes. Keep hardwood cuttings (see p. 98) frost-free

Sow seeds outdoors (see pp 103-04) where they are to flower in 6-12 months when the soil reaches 50°F (10°C)

### BUXUS BOXWOOD

GREENWOOD CUTTINGS from early to mid-ummer 1 SEMI-RIPE CUTTINGS from Live summer to rate 4 orrutus DIVISION IN Spring 1 SEEDS in early spring &

Use a free-draining medium to root cuttings of the evergreen shrubs in this genus. Take nodal stem-tip cuttings. from greenwood (see p.101). Semi-ripe cuttings (see below) root in 6-8 weeks outdoors, or under cover in cold climates They root more quickly if placed under plastic and given bottom heat

Buxus sempervirens and its cultivars can be divided using a spade (see p 101) Sow seeds after a short period of cold (see pp 103-04) for more even germination Boxwood is slow-growing, more so from seeds, so it may take 4-5 years to obtain a plant ready for planting out

#### BOXWOOD CUTTINGS



Rodf large numbers of 4th (10cm) semi-ripe L cuttings (here of Baxus sempervirens) in cells or soil mix plugs (see inset). The following spring, pot the cuttings singly into Jin (8cm) pots



2 tegularly in the autumn, plant them out into a well-prepared nursery had, spacing them 12 (8in (30-45cm) and grow on for 3-4 years

### CALLICARPA BEAUTYBERRY

SOFTWOOD CUTTINGS IN early summer \$\$ SEMI-RIPE CUTTINGS from early summer 11 HAROWOOD CUTTINGS in late autumn to midwinter I SEEDS in autumn or spring |

Softwood and semi-ripe cuttings (see pp 100 and 95) of the shrubs in the genus root best with hormone rooting compound. For Callicarpa japonica, try hardwood cuttings (see p 98). Sow seeds from the fruits fresh or dried (see pp. 103-04)

p.95) than you need in colder chimates, since rooted cuttings do not always overwinter well. When taking hardwood cuttings (see p.98), check that the wood is living (green below the bark) - many of the new shoots may die back. They root easily if kept cool and humid

CAMPSIS TRUMPET VINE

HARDWOOD CUTTINGS from autumn to midwinter 1

The roots of these vigorous, deciduous

climbers, if taken as cuttings while the

plant is dormant (see Celastrus, p. 122),

Take more semi-ripe cuttings (see

produce strong plants that are more

easily overwintered than those from other cuttings. A flowering plant may

SEMI-RIPE CUTTINGS in summer 11

LAYERING in summer or winter !

be raised in three years.

ROOT CUTTINGS in winter 1

SEEDS in spring 1

Seeds gathered in autumn from dry capsules and sown in spring (see p.104) germinate readily. Campsis radicans climbs by means of aerial roots and is a good plant for self-layering (see p 107)

### CAMELLIA

SEMI-RIPE CUTTINGS from mid-animer to early autumn 11 HARDWOOD CUTTINGS from autumn to late winter III SEEDS in autumn or spring | LAYERING IN Spring & GRAFTING in mid- to late winter 111

Most of the evergreen shrubs in this genus root from semi-ripe cuttings (see p 95) They need care and free-draining medium in colder climates but are easy in warmer regions. Cuttings may be internodal or nodal (see below), with kin (1 5cm) wounds, but nodal up cuttings produce a flowering plant quickly, in 3-4 years. Apply hormone rooting compound sparingly on single-node cuttings. With hardwood cuttings (see p 98), pinch out flower buds and give bottom heat of 54-68°F (12-20°C) rooting takes 6-12 weeks

Gather seeds as soon as the fleshy fruits split. Sow fresh, or soak the hard seed coats in hot water before sowing in spring (see pp 103-4). Camellias make good subjects for hybridizing (see p 21)

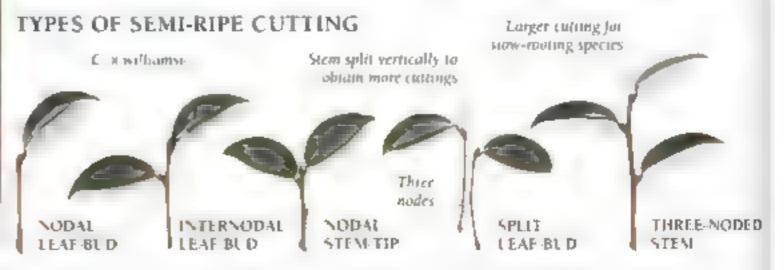


HYBRIDIZING CAMPILIAS

To prepare a camellia for pollmation, select a bloom that has not fully opened (see inset) and carefully remove atl the petals and stamens with a pair of tweezers to expose the stiginas

Simple layer (see p 106) low-growing shoots of no more than hin (12mm) diameter. Allow up to two years for the layer to root before lifting.

Camellia reticulata and its cultivars are more successful if grafted than when taken as cuttings. Apical-wedge (see p 108), whip (see p 109) or cleft graft (see right) onto two-year-old seedlings or cuttings of C. Japonica, C. saluenensis, or C. reticulata to flower in 2-3 years



### **CARYOPTERIS**

BLUEMIST SHRUB

SOFTWOOD CUTTINGS from spring to midsummer I GREENWOOD CUTTINGS from late spring to midsummer I

SEMERIPE CUTTINGS from mide to late summer & HARDWOOD CUTTINGS from late autumn to midwinter &

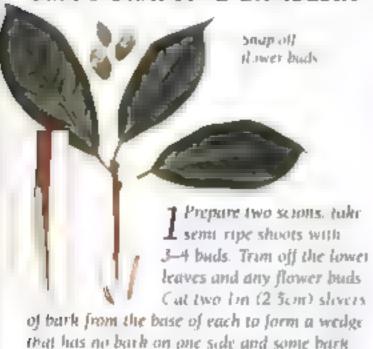
SEEDS in spring |

The deciduous substrubs in this genus root readily from softwood and greenwood cuttings (see pp 100-01) and are prime candidates for rooting directly in a 3½ in (9cm) pot (see p.96). Rooting occurs within three weeks in a warm, humid environment. Treat semi-ripe cuttings (see p.95) as above or root in a cold frame or clocke. Hardwood cuttings (see p.98) also root well in frost-free sites outdoors or in containers on a heated bench in a frost-free greenhouse.

Seeds gathered from dry fruits in autumn, dried, then sown in spring (see pp 103-4) germinate readily. New plants

flower in 2-3 years

#### CLEFT GRAFTING CAMELLIA



and the lowest paid on the other (see inset



2 Cut the rootstock down to 3m (8cm) and make a 1m (25cm) vertical cut into the top. Slide one of the scions into each end of the cut, so that the bark of the scion is flush with that of the stock (see mset). Seal the union with grafting wax and allow to callus.

### CEANOTHUS CALIFORNIA LILAC

Softwood currings from late spring to midsummer 1

SEMI-RIPE CUTTINGS from midsummer to late autumn 11

HAROWOOD CUTTINGS from late autumn to late winter #4

ROOT CUTTINGS in autumn 11
SEEOS in late winter 111

These are evergreen and deciduous shrubs. Evergreens are best grown from semi-ripe or hardwood cuttings, and deciduous shrubs from softwood cuttings, to flower in 2–3 years. All species may be seed-raised

#### CUTTINGS

Nodal stem-up softwood cuttings (see pp. 100-01), 3in (8cm) long, of deciduous and semi-deciduous cultivars root in 4-6 weeks in a free-draining medium with hormone rooting compound. Take semi-ripe cuttings of evergreen cultivars with a heel (see pp. 95-6) if possible. Bottom heat of 54-59°F (12-15°C) will speed rooting.

Hardwood cuttings (see p.98) of small-leaved species such as Ceanothus impressus and their cultivars need a dry

rooting medium to prevent rot, they root well in rockwool plugs. Take root cuttings as for Celastrus (see p.122)

#### SEEDS

Soak the hard seeds in hot water before sowing (see pp 103-4). Some species need three months' chilling, others respond to smoke treatment.



CEANOTHES 'PIN CUSHION'
Cuttings of this and other evergreen Ceanothus
are best taken with a heel, If possible, from sentripe wood to encourage moting

#### OTHER SHRUBS AND CLIMBING PLANTS

Burter Rum. Semi-ripe cuttings (see p. 100) in summer | Sow seeds in spring (see p.104) | CALSALPINIA Root softwood and greenwood cuttings (see pp 100-01) in spring and summer in a free-draining medium 1. Sow seeds as for Chambus (see p.124), tender species require 68-77°F (20-25°C) [ CALCEULARIA Take softwood cuttings (see p 100) in spring and early summer Bottom heat is not needed cuttings will rot if the environment is too damp \$1. Sow seeds in spring (see p. 104), no heat is needed 11 CALLIANURA Take semi-ripe cuttings (see p 95) in summer & Simple layer (see p. 106) in spring 1. Sow seeds in spring (see p 104) at 61-64°F (16-18°C) after treating with smoke (see p. 103) 1.

CALLISTENCY Root greenwood to semi-npe cuttings in summer and autumn as for Oleana (see p. 135) §. Surface-sow seeds in spring (see p. 104) §.

CALLUNA See pp 110-11
CALOCHUNE Take semi-ripe
cuttings (see p 95) in summer I.
CALOTHAMMUS Root greenwood to
semi-ripe cuttings in summer and
autumn as for Oleana (see p.135) I.
Surface-sow seeds in spring (see
p.104) I

CALYCANTHUS Root greenwood and semi-tipe cuttings (see pp 101 and 95) in summer in a free-draining medium with bottom heat []. Sow seeds in autumn (see p. 103) [].

CALYTRIX Root greenwood to semi-ripe

Ottogs in summer and autumn as for Oleana (see p.1.15) 1

CANTUA Root greenwood and semi-ripe cuttings (see pp 101 and 95) throughout summer with gentle hottom heat 1, 50% seeds in spring (see p 104) 1 CARAGANA Take cuttings in summer as fer deciduous Vibarmon (see p.143) 1. Treat seeds as for Chanthus (see p 124) L. Topwork weeping forms onto C arborescens as for Salec caprea var pendala (see p 89) [ CARBSA Take semi-ripe cuttings (see p.95) in summer 1. Sow seeds in autumn or spring (see pp 103-04) at 64-70°F (18-21°C) L CARMICHAELIA Root semi-ripe cultings from nitdsummer to autumn as for Olegria (see p 135) L. Seeds as for Chanthus (see p 124) L CARPENTERIA Often micropropagated, take greenwood cuttings (see p 101) from nucropropagated stock to obtain better rooming 11. Sow seeds in spring (see p 104)

at 77°F (25°C) [1.]

Cassima Root cuttings as for Lavandula (see p 132); cuttings can rot off [1.]

Cassions Take greenwood cuttings as for evergreen azaicas (see Rhododendron, p.138) [.] Sow seeds and layer as for Erica (see pp 110–11)

Castanopsis Sow seeds in

autumn (see p 103) }.

CALLISTEMON CITRINUS
E-REBRAND

### CELASTRUS BITTERSWEET



Cetastrus moculatas

SOFTWOOD OR GREENWOOD CUTTINGS in early summer 1 ROOT CUTTINGS in winter 1

For this genus of mainly deciduous climbers, nodal softwood or greenwood cuttings (see pp.100-01) may be taken from the stem-

tips and will root well. Several cuttings may also be taken from one shoot. Prune growth on new plants by about 50 percent to ensure a well-branched plant. New plants from cuttings reach maturity in 3-4 years.

One length of root provides several cuttings, without any special care or facilities. Trim root cuttings (see below) to size using a sharp knife or pruners Discard thin roots, and ensure only undamaged material is used

In colder climates, cuttings will root and produce shoots in a cold frame but respond more quickly in a frost-free greenhouse. If they are slow to shoot, place them on a heated bench for a couple of weeks. They should be ready for potting in spring. Alternatively, insert two cuttings directly in a 3/2in (9cm) pot to avoid any root disturbance

### TAKING BITTERSWEET ROOT CUTTINGS



Dog a hote 18-24m (43-60cm) from the have of the parent plant to expose the roots it move that are between the thickness of pencil and a trigger catting straight across at the top of each root. Veash off the soil and divide the roots into 17-2at (4-5cm) sections (see suser).



2 were the e-drawing scale so pottone or very literal Press the cuttings very elly more only one that the flat-cut ends are slightly above the surface Space them 2–3m (5–8cm) apart Cover with a zim (1cm) layer of sharp said Water, label, and heep in a frost-free place

## CHAENOMELES FLOWERING OR JAPANESE QUINCE, JAPONICA

SOFTWOOD OR GREENWOOD CUTTINGS in late spring to early summer []

HARDWOOD CUTTINGS from autumn to midwinter !
ROOT CUTTINGS from autumn to midwinter !
SEEOS in autumn or spring !
LAYERING in late winter !

Hardwood cuttings of these deciduous shrubs produce a large plant more quickly than other methods, usually in 2-3 years. Spreading forms are easy to layer

#### CUTTINGS

Nodal stem-tip softwood or greenwood cuttings (see pp 100-01) are best taken with a heel (see p.96) and respond to hormone rooting compound. Humidity of 100 percent prevents scorch. Rooting takes about four weeks. Hardwood cuttings (see p.98) with a wound root easily if treated with hormone rooting compound and kept cool and humid

Root cuttings should be 'sin (8mm) in diameter and 3in (8cm) long, treat as for Celastrus (see above), but place horizontally on the surface and lightly cover. You can also root cuttings in nursery beds (see p.96).

SEEDS

Gather seeds from ripe fruits (see below) and sow fresh in autumn (see p. 103). Alternatively, sow seeds in spring after providing a three-month period of cold stratification (see pp. 103-4).

#### LAYERING

Simple layering (see p 106) is very effective. Layers should be ready to lift in spring



Collecting flowering Quince seeps Watt until the fruits have turned vellow and come easily off the branch in autumn. Using a sharp knife, cut through the outer flesh carefully by scoring around the fruit once. Twist open the fruit so as not to damage any seeds. Pick out the seeds with a blunt knife or plant label.

### **CISSUS**

CUTTINGS at any time 1

This large genus includes a range of shrubs and vines that can be easily increased from cuttings. New plants will flower in two years. Softwood and semi-ripe nodal or internodal cuttings (see pp. 100 and 95), 2½—3in (6–8cm) in length, will root readily. If the cuttings are kept warm at 68–77°F (20–25°C) and humid, rooting usually takes 3–6 weeks

### CISTUS SUN ROSE, ROCK ROSE

SOFTWOOD CUTTINGS from late spring to early summer \$\frac{1}{4}\$
SEMI-RIPE CUTTINGS from midsummer to at a winter \$\frac{1}{4}\$
SEEDS in spring \$\frac{1}{4}\$

Cultings of these small to mediumsized evergreen shrubs must be protected against rot. Seeds may be sown as for bedding plants to obtain flowering plants in two years.

#### CUTTINGS

Softwood cuttings (see p 100) root readily. Cistus produce many sideshoots, and it is important to select material carefully (see below). Rooting takes up to four weeks. You can also root directly in pots (see p 96).

Semi-ripe cuttings (see p.95) do we in a cold frame over winter. Maierial taken in late winter from stock plants (grown under cover in colder climates) before new growth commences roots quickly. Watch out for powdery mildew, particularly on C. x purpureus and its cultivars, this reduces rooting potential If present, the foliage will be weak, with vellow and brown blotches. Spray the plant with a fungicide before taking cuttings from it

#### SLEDS

Seeds from dry capsules germinate readily Sow them (see pp 103-04) in a sheltered sunny site, where they are to flower, or in a seedbed

Rtals of saituble size

SOF TWOOD CUTTINGS
In early summer, be sure
to choose a nor flowering
shoot with buds at the
correct stage for softwood
cuttings. If the buds are
overgrown, they may die
off, leaving the moted
cutting "blond" and
unable to produce any
new shoots.



### CLEMATIS OLD MAN'S BEARD, TRAVELER'S JOY, VIRGIN'S BOWER

CUTTINGS from spring to late summer | Secos in autumn | LAYEAING in late winter to spring | GRAFTING in late winter |

Of the deciduous and evergreen climbers in the genus, deciduous cultivars are often grown from softwood cuttings and species from semi-ripe cuttings. Layering (see p. 107) is most suited to Clematis montana and its cultivars. Grafting larger-flowered hybrids ensures more vigorous plants. Sow seeds of species. It usually takes 2–3 years for new plants to flower.

#### CUTTINGS

Leaf-bud cuttings (see p 97) can be taken from softwood and semi-ripe shoots. They are prepared in the same way (see below), but cuttings of softwood are taken from spring to midsummer and of semi-ripe wood from mid- to late summer. They all root well, but semi-ripe cuttings need less humidity. For large leaved softwood cuttings, for example in some of the Clematis montana cultivars reduce the cutting to a single leaf to avoid overcrowding and botrytis.



#### COLLECTING AND SOWING CLEMATIS SEEDS



I thouse other law and pull one is the upon the plantes from the seeds

Pot rooted semi-ripe cuttings (see p 95) in spring. C. armandii and its cultivars root well from semi-ripe or hardwood cuttings (see p 98) taken in midwinter 4–6 weeks before new growth starts and inserted in rockwool plugs. Each cutting must have a well-formed bud. Apply hormone rooting compound and keep humid with 54–59°F (12–15°C) bottom heat. Once rooted, pot and grow on the cuttings in a moist atmosphere

LEAL-BYD CUTINGS

rate internodal leaf-bud cuttings

raint 2m (Sem) long from the

current seasons growth. Look for
well formed buds in the leaf axils
weak buds may not produce new
shoots. Larger-leaved cultivars, such
as this Clematis armandir, should be
trummed to only one leaf-rather than
two. If necessary, cut the leafiets in
half to reduce morsture loss.



2 fee drawing soil mix. Cover with a that layer of mix and top-dress with gent Laber

#### SEEDS

Gather and sow seeds fresh in autumn (see above). They need a period of cold stratification (see p. 103) to ensure even germination in spring.

#### LAYERING

Serpentine layer (see p.107) shoots of the previous season's growth. The layers should root by the following summer

#### GRAFTING

Use one- or two-year-old C vitalba seedlings as rootstocks. Take 1%in (3.5cm) scions from the current season's growth of the cultivar, cut just above a bud. Apical-wedge graft (see p.108) the scions onto 3in (8cm) long and %in (3mm) thick roots. Pot singly so that the buds are level with the soil mix surface. Each root will sustain its scion until the scion produces its own roots and is self-supporting (this is called a nurse graft).

### CLERODENDRUM GLORY BOWER

SOFTWOOD CUTTINGS in late spring to early stream of §
SEMI-RIPE CUTTINGS in summer §
ROOT CUTTINGS in autumn to midwinter §
SEEDS in spring §
DIVISION from late winter to spring §

The evergreen and deciduous shrubs and climbers in this genus root readily from softwood and semi-ripe cuttings (see pp. 100 and 95) in 3–6 weeks. Take root cuttings as for Celastrias (see p. 122) but insert singly in 3½in (9cm) pots for flowers in 2–3 years. Gather seeds from the fruits, then provide a three-month period of cold stratification before sowing in spring (see pp. 103–04)

Take advantage of natural suckers of Clerodendrum bunger by separating them (see right) in spring. Mature plants of clump-forming species can be divided from late winter to spring (see p 101). Suckers will flower in the same year.



Dividing Clerothendre M BUNGE!
Select a healthy sucker (left in picture) with its
own fibrous roots. Remove the soil carefully from
between the parent and the sucker to expose the
underground stems (stolons) linking them. Since
through the stolons with the blade of a spade
Lift the sucker, trim any damaged or overlang
roots, and plant out in prepared soil

OTHER SHRUBS AND CLIMBING PLANTS

CLERALANTHUS Take semi-ripe cultings in summer or hardwood in winter (see pp 95 and 98) 1. Sow seeds in autumn (see p 103) 1.

CERATOSTIGMA Take softwood cuttings in early summer as for Fuchsia (see p. 128) 1 CESTRUM Take softwood to semi-ripe cuttings (see pp 100-01 and 95) 1. CHIMORANTHES Take softwood cuttings with a heel (see pp 100 and 96) in late spring 11. Simple layer (see p 106) 11. Sow seeds in autumn (see p. 103) 11 CHIONANTHUS Sow seeds in autumn (see p 103) to germinate after two winters 🚻 CHOISEA Root greenwood to hardwood cuttings as for Escallonia (see p.127) | K CITROFORTI NELLA ROOI SCHII-ripe cuttings in summer (see p 95) L. Air layer in spring (see p. 105) 1 CLETHRA Take cuttings as for evergreen azaleas (see Rhododendron, p 138) 1. Sow seeds as for Rhododendron (see p.138) 1

### CLIANTHUS GLORY PEA

Currings from late spring to early autumn & SEEDS in spring & GRAFTING in spring &

These evergreen to semi-evergreen climbing shrubs root readily from softwood and semi-ripe cuttings (see pp 100 and 95). Take stem cuttings from new growth, trimming just below a node, and reduce the compound leaf by up to half. Rooting takes about four weeks; pot early-rooted cuttings into 3 /4 in (9cm) pots. Water sparingly over winter, and pinch out tips for bushy plants. Slug damage can be severe.

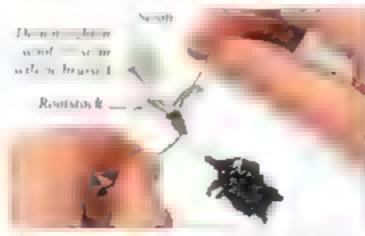
Gather the hard seeds from the long hairy pods, then scarify by abrading or soaking (see p.102) prior to sowing to ensure good germination, in 10–14 days

The desert pea, Chanthus formosus, recently renamed Swainsona formosa, is very short-lived unless grafted (see right) onto seedlings of C. puniceus or Colutea arborescens. Use stock seedlings that have been germinated ten days earlier than the scion seedlings. Work as quickly as possible to prevent the cuts from drying, keep the scion, Grafted plants flower in 1–3 years

#### GRAFTING A CHANTHUS FORMOSUS SEEDLING



I When it has two seed leaves, carefully lift the rootstock seedling (Colutea arborescens) With a sterilized razor blade, slit the top Sin (1 Sem) of the stem, starting between the caves



3 the stock seeding, as far as it will go Bind the graft with soft knowing varn. Pot the grafted wedling in soilless seed mix in a 2in (5cm) pot Set the graft just above soil level.

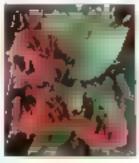


2 Lift a Clianthus formosus seeding, also at the two-leaf stage. Cut off the roots, making an angled cut on each side of the stem to form a wedge at the base (see inset).



4 Place in a humid case at a minimum of 64% (18%) Once the graft has taken (see taset, and the seeding is in active growth remove the carr. Cut it away carefulty with a scalpel, hold the seeding steady with tweezers.

### CODIAEUM CROTON



Caltaram Plamingo' CUTTINGS at any time | LAYERING at any time |

If several plants are required, cuttings are easily taken from the evergreen shrubs in this small genus. Take softwood and greenwood nodal stem-

tip cuttings (see pp. 100-01), and dip the cut stems in powdered charcoal to staunch the sap before inserting them in the medium. Supply 68-77°F (20-25°C) bottom heat. Cuttings should root in 4-6 weeks. New plants should mature in two years

If only one or two new plants are required, crotons can be air layered (see p. 105) for a good-sized plant in a year

### CORNUS DOGWOOD

SOFTWOOD CUTTINGS in late spring or early summer 11
HARDWOOD CUTTINGS from a value of a midwinter 11
Division from late winter to early spring 1
SEEDS in autumn 1
GRAFTING in late winter 11

The deciduous shrubs in this genus are usually easy to propagate Cornus alba and C. stolonifera and their cultivars do not root readily from softwood take nodal cuttings at the correct stage (see right and p. 100), no more than 2%in (7cm) long, from the new stem tips Use a free-draining medium and a weak hormone rooting compound. Rooting takes about four weeks

The best way to increase dogwoods grown for their colorful winter stems is

to root hardwood cuttings (see p 98) in a sheltered site. Sow seeds gathered from ripe fruits fresh in autumn (see p.103) before they become dormant, or cold stratify (see p 102) seeds to be sown in spring Lift and grow on rooted suckers of C. stolonifera (see p 101). Spliced side graft (see p 58) hard-to-root cultivars of C. florida such as Rubra

SOLIWOOD CLITING MATERIAL lake cuttings fust as bre aring pores, or lennicels, begin to form

on the stem. This Cornus alba Elegantissima' cutting has well developed lenticels (see inset) at the base and will not root easily



COBAEA Sow seeds in spring (see p. 104) 1.

COLLETIA Root semi-ripe cuttings (see p. 95) in autumn in open medium with gentle heat 1.

COLUTEA Take softwood cuttings (see p. 100) 1. Treat seeds as for Chanthus (see above) 1.

CONVOLVOLUS Take semi-ripe cuttings (see p. 95) in summer

and autumn, keep dryish 11
CoptosMA Take semi-ripe
cuttings as for Pittosporum (see
p.137) 1. Sow seeds in spring
without extra heat (see p.104) 1.
Conoxia Softwood cuttings (see
p.100) in summer 11. Semi-ripe
cuttings (see p.95) in summer
and autumn; keep dryish 11.
Coroxilla Take greenwood

stem-tip cuttings (see p. 101) in early summer 11. Sow seeds as for Chanthus (see above) 11. Conflores Softwood cuttings as for Syringa (see p. 142) 11. Seeds sown outside in spring (see p. 104) take two years to germinate 11. Simple or French layer in spring or ausumn (see p. 106) 1. CUPHEA. Root softwood to semi-

ripe cuttings (see pp 100–01 and 95) from spring to autumn ‡. Sow seeds in spring (see p 104) ‡. Cyrilla Root semi-ripe cuttings (see p 95) from midsummer in a free-draining medium ‡‡. Take root cuttings as for Celastrus (see p 122) ‡‡. Sow seeds in spring (see p 104) ‡‡. DABOECIA See pp 110–11 ‡

### CORYLUS FILBERT, HAZEL

CUTTINGS in late spring to early summer \$4
SEEDS in autumn \$
LAYERING in late winter and spring \$
GRAFTING in late winter \$1

Some of these shrubs tend to sucker, especially grafted plants. Avoid this with purple-leaved Corylus maxima cuntivars by taking softwood nodal stemtip cuttings (see p. 100), no more than 3-4m (8-10cm) long with the tip and one juvenile leaf retained. They will root in rockwool plugs in 4-8 weeks. Lightly wound the bottom %in (2cm) of the stem of each cutting and apply some hormone rooting compound.

Seeds gathered and sown fresh (see p 103) germinate well if subjected to a period of winter cold

C avelland and C maxima cultivars are often French layered (see p.107). They can also be stooled (see p.56); to improve results, wound young shoots and treat with hormone rooting compound before hilling up.

Whip graft (see p.109) named cultivars onto C avellana rootstocks for good-stzed plants in 2–3 years

### COTONEASTER



SOFTWOOD OR GREENWOOD
CUTTINGS from spring to
midsummer 
SEMI-RIPE CUTTINGS from
midsummer to autumn 
SEEDS in spring 
LAYERING in late winter 
GRAFTING in late winter 
\$\frac{1}{2}\$

Commenter This large genus subclibbins 'Gnom' includes a wide range of deciduous and evergreen shrubs, which all root well from cuttings. The prostrate forms lend themselves to

which all root well from cuttings. The prostrate forms lend themselves to layering, and grafting may be used to create a standard plant. New plants usually mature within 2-3 years.

#### CUTTINGS

All cotoneasters root readily from softwood and greenwood cuttings (see pp 100–01); take stem cuttings of species with long shoots, such as Cotoneaster dummeri. Cotoneasters are good candidates for rooting directly in pots (see p 96). C. integrifolius roots best when the growing tip is retained.

In colder areas, semi-ripe cuttings (see p 95) can be rooted in a cold frame

If rooting cuttings under plastic or in a closed case, rooting occurs more rapidly with bottom heat

#### SEEDS

Extract the hard-coated seeds from npe fruits (see p. 102) in autumn and provide periods of first warm and then cold stratification before sowing in spring (see pp 103-4). They should germinate in the following year. Cotoneasters hybridize freely and they do not generally come true.

#### LAYERING

Simple layering (see p 106) works well if only one or two plants are required Plants may also self-layer (see p.107)

#### GRAFTING

Whip graft (see p.101) scions of C. 'Hybridus Pendulus' onto a tall, straight-stemmed rootstock to produce a weeping shrub or a small tree. This is known as top-working (see Hedera, p.130). Use a two-year-old pot-grown C bullatus or C frigidus as a rootstock

### COTINUS SMOKE BUSH

CUTINGS in spring [1].
SEEDS in late summer to early autumn or spring [].
Levering in late winter or early spring [].

Increasing the large, deciduous shrubs in this genus from cuttings or seeds can be tricky. Simple layering is the easiest way to obtain one or two new plants, but using a stock plant for French layering will yield many more. A good-sized plant may be obtained in 2–3 years.

#### CUTTINGS

Insert thin softwood nodal stem-tip cuttings (see pp 100-01), 1 /2-2 /m (4-6cm) long with 2-3 young leaves, in free-draining medium. Hormone rooting compound and a moist atmosphere aid

rooting, which takes up to six weeks. In cooler areas, encourage rooted cuttings to put as much growth on as possible before autumn, since they often fail to overwinter if too small.

#### SEEDS

Seeds gathered as they ripen (see below) and sown fresh (see p. 103) germinate well in spring. Stored seeds develop hard coats so must be scarified and cold stratified (see p. 103) for spring sowing

#### LAYERING

Simple layer (see p. 106) in late winter for rooted layers by autumn. If French layered (see p. 107) in spring, a bush sends up a host of new shoots that will also be well rooted by autumn

### CYTISUS BROOM



Cytisus a pracrax

SEMI-RIPE CUTTINGS in late summer of early autumn [1] HARDWOOD CUTTINGS in midwinter [1] SEEDS in autumn or spring [

New plants of these deciduous and evergreen shrubs usually flower within

two years. Root semi-ripe cuttings with or without a heel (see pp 95-6) in a very free-draining medium or rockwool plugs. Overwatering leads to basal rot. Humidity, bottom heat of 54-59°F (12-15°C), and hormone rooting compound speed rooting, but it still takes 2-6 months. For Cytisus x praccox and its cultivars, well-ripened hardwood cuttings of strong, juvenile stems (see p 98) root best with humidity and bottom heat. Spray every two weeks with a fungicide and ventilate weekly

All species grow readily from seeds, but hard seed coats can be a problem Sow freshly gathered seeds outdoors in autumn (see p 103) to germinate in spring. Transplant pot-sown seedlings at the seed-leaf stage into 3½in (9cm) pots for planting the following autumn Soak spring-sown seeds in hot water (see pp 103–4) before sowing. Seedlings of Cytisus battandieri (syn. Argyrocytisus battandieri), the pineapple broom, may need a second growing season before planting out. Protect young plants from mice and rabbits

#### EXTRACTING SMOKE BUSH SEEDS



1 Take some shalfy Cottons seedheads and "scrunch" them over a sheet of paper to separate the black seeds from their plumes

2 Hold up the sheet
2 of paper and gently
blow away the loose
plumes. Sow the seeds
in a small pot filled
with soilless seed
mix (Do not
worry if any
chaf) falls
on the mix.)
Cover with
a fine layer of
mix, water,
and label



### DAPHNE



Dapta. 4 22 493

GREENWOOD CUTTINGS IN spring to early summer !! SEMI-RIPE CUTTINGS IN summer 👪 ROOT CUTTINGS in autumn and winter L SEEDS in midsummer or autumb L LAYERING IN late spring to early summer | GRAFFING IN WINTER 1

These deciduous and evergreen shrubs hate drying out, so however they are propagated, keep new plants moist Daphnes are fickle rooters because of the presence of virus in most plants, Daphne x burkwoodit, D eneorum, D odora, and their cultivars are easiest to root Root cuttings of Daphne mezereum and D. genkwa work well. Daphnes do not tolerate root disturbance

D mezereum is often raised from seeds. Species with prostrate or spreading growth, such as D. blagayana and D encorum, are best lavered. The more difficult species and hybrids are grafted, it can be tricky with small alpines but is usually successful New plants flower in 2-3 years

#### CLITINGS

Take nodal stem-tip greenwood and semi-ripe cuttings (see pp. 101 and 95), 2-4m (5-10cm) long, just as the base begins to firm up. Hormone rooting

compound, a free-draining medium, and bottom heat of 59°F (15°C) will improve rooting. For alpines, take 4-2 Ain (1 5-7cm) cuttings and use a mix of 2-3 parts coarse sand to one of peat. In cold climates, cuttings can be rooted in a cold frame. Cuttings with virus often drop their leaves, destroy them. Healthy cuttings take 6-10 weeks to root. Take root cuttings as for Celastrus (see p 122)

#### SEEDS

Harvest the ripe fruits (see p. 103) and remove the pulp but there is no need to clean the seeds completely. Sow at once in containers (see p 104) in gritty seed soil mix and place in a frost-free place Most germinate in spring after a winter's chilling. Leave for another year to germinate all the seeds. For alpines, stratify fresh seeds in layers of moisi peat or sand in pois outdoors or in a refrigerator for six weeks (see p. 103) Dried seeds germinate less successfully

#### LAYERING

Simple-layered (see p. 106) shoots take a year to become well rooted. Daphnes may also be air layered (see p. 105)

#### GRAFTING

Water the rootstocks well in their pots prior to grafting (see below). For scions. use strong, healthy cuttings of the previous year's growth - about 1-2in (2.5-5cm) long for alpines, and standard length for other daphnes.

#### TYPES OF GRAFT USED FOR DAPHNES



SPUICED SIDE-WHIP-AND-VENHER TONGUE Sec # (199) (sec p 50)

Wedge cut OR SCION Stock cut partinities. PERMS

WRIP

(see p 109)

APICAL. WEDGE eser p 1081

Daphnes may be grafted using one of several techniques (see left) The rootstocks most with by used are two-year old Darling spena and he grade 1 1 1 11 near cup har newly grafted plants first moist for at least ten days

### ELAEAGNUS AUTUMN OLIVE, OLFASTER

SEMI-RIPE CUTTINGS from late summer to natatite 11 HARDWOOD CUTTINGS from site autumn to late. winter II DIVISION in spring \$ Seeps nautumn 1

Cuttings from the deciduous and evergreen shrubs in this genus normally root well, but in some years they are prone to leaf drop and will not root Plants that produce suckers may be divided. New plants should be ready to plant out in 2-3 years.

### CUTTINGS

Etaeagnus x ebbinger and its cultivars root more reliably than E pungens. With the latter, select material with large, bright, shiny leaves. Take nodal semiripe stem cuttings (see p. 95), 3-4in (7-10cm) long and with 2-3 nodes, retaining only the top two leaves. Wound the bottom \(\frac{1}{2}\)in (2cm) Bottom heat at 59-68°F (15-20°C) speeds rooting, which takes 8-12 weeks.

Take hardwood cuttings (see p 98) of the most vigorous growth and root in a frost-free, humid environment. The cuttings should root in 12-20 weeks.

#### DIVISION

E commutata spreads by suckers. Laft, divide, and transplant suckers of a mature plant (see p. 101)

#### SEEDS

Gather seeds from ripe fruits and sow fresh in autumn (sec p.103); they benefit from winter cold. E. pungens seeds ripen in spring and may germinate at once; if not, treat as autumn sowings



### ENKIANTHUS

CUTTINGS in late spring to early summer 11 SEEDS in winter to early spring 11

Root softwood cuttings from the mainly deciduous shrubs in this genus as for deciduous rhododendrons (see p 138) In colder areas, rooted cuttings may fail to overwinter because the growing season may not be long enough for the new wood to ripen fully. Treat seeds gathered from dry capsules as for rhododendrons (see p. 138). New plants take 4-5 years to Rower

### **EPIPREMNUM**

CUTTINGS at any time 1 LAYERING at any time \$

These evergreen, woody climbers produce aerial roots along their stems, cuttings taken from such shoots root very easily

Take softwood stem tip (see p 101) or semi-ripe leaf-bud cuttings (see p 97), pot them individually, and provide bottom heat of 68°F (20°C) Mature plants may be had from cutungs in 2-3 years and from simple (see p 106) or air layering (see p. 105) in 1-2 years.

### ESCALLONIA

GREENWOOD OR SEMI-RIPE CUTTINGS From midsammer (o autumn 1 HARDWOOD CUTTINGS from late autumn to rate Winter !

Most of these mainly evergreen shrubs can be increased from greenwood or semi-ripe cuttings Rooting of 4in (10cm) greenwood stem cuttings (see p.101) takes 4-8 weeks. Semiripe cuttings (see p.95) will also root reliably in a cold frame over winter

Less vigorous cultivars with more twiggy growth root more readily from hardwood cuttings. Hardwood cuttings (see p 99) are also less prone to basal stem rot. They can be taken in one of two lengths 8-10in (20-25cm) or 4in (10cm) (see below). Root in a frost-free, humid environment or in mild areas, outdoors. The young plants should be large enough by the following autumn to lift and replant in the garden. It takes 2-3 years to obtain a flowering plans



HARDWOOD CL THNGS

If material is landed take shorter on (10cm) cuttings. It on leaves off the lower half of each stem. Disa peat and back mix, ciatoigs noot m 6-70 works

## EUONYMUS BURNING BUSH, SPINDLE TREE

SOFTWOOD OR SEMI-RIPE CUTTINGS from late spring to late summer 1 GREENWOOD CUTTINGS in late spring 11 HAROWOOD CUTTINGS from autumn to late winter 1

SEE08 in autumn !

GRAFTING in late winter 1

This genus includes deciduous and evergreen shrubs and climbers that root readily from cuttings. Greenwood cuttings are best for Euonymus alatus, hardwood cuttings for E japonicus and its cultivars. Deciduous species can be raised from seeds. New plants mature in three years. Wear gloves when handling E europaeus and other species that irritate the skin

#### CUTTINGS

Softwood or semi-ripe cuttings (see pp 100 and 95), 2-4in (5-10cm) long. root within four weeks. Leaf drop can occur if material has powdery mildew

on the foliage, so select only healthy maternal. Since rooting can take up to ten weeks, take greenwood cuttings (see p 101) of E. alatus as early as possible and from a shrub that still produces vigorous new growth each year. Hormone rooting compound is beneficial. Root hardwood cuttings (see pp 98-9) of E japonicus and its cultivars in a frost-free, humid place Plant out rooted cuttings in autumn

#### SEEDS

Seeds harvested from ripe fruits (see below) and sown fresh in autumn should germinate in the following spring after a period of chilling (see pp 103-4)

#### GRAFTING

Use seedlings rootstocks of E europaeus to spliced side graft (see p 58) its cultivars Whip-and-tongue graft (sec p 59) E fortunet cultivars for a standard

> EUONYMUS SEEDS These should have very colorful frants that split open to reveal their seeds in autonor To collect the blood-red seeds of this Evenymus Battistomanus subsp. sicho Jianus, tre a paper bag over a stembefore the capsules split Remove the fleshy orange outer seed coats cards) before sore ng



#### OTHER SHRUBS AND CLIMBING PLANTS

DECASNEA. Sow seeds in automnsec p. (03) 2 DENDROMECON ROOT softward cuttings (see p 100) in free draining medium []. DESPONTAINIA Take semi ripe cuttings (see p 95) from midsummer to auturum historia heat is not essential 4 DECTZIA Propaga cus l'ir Philadelphas (see p 136) | DHRV HA Take softwood to semi-rape ciatings (see pp 100-01 and 95) 1 DIPELTA Root greenwood to semi-ripe cuttings (see pp 101 and 95) 1. Sow seeds in spring (see p 104) L DISANTHUS Take softwood cuttings as for Hamanichs (see p 130); overwintering rooted cuttings can be difficult 111

Simple layer (see p 106) 111 Daixiys Root softwood to semi tipe cut ings (see pp 100-01 and 95) L. Older plants may self-layer (see p 107) L DRIANCRA Root softwood cuttings (see p 100) in summer 111. Sow seeds 2-3 to a not in spring (see p 10H) at 64°F. (18°C): some need smoke treatment (sci. p.103) L. ECCRESION SPUS SOW seeds in spring (see p 104) at 50-59°F (10-15°C) & Seeds of E scaber need light to germinate EUGTWORTHIA ROOT greenwood and semi-tipe nodal stem-tip cuttings (see pp 101 and 95) in summer in free-draining ricdium # Split bottom #-lin (1-2cm) of stem ELECTHEROCOCCUS Take

greenwood cuttings (see p 101) in early surrer or those or mags as for Celastrus (see p. 122) 1 Divide suckers in late winter (see p. 10114. Sow seeds in a number of spring (see pp 103-1) [ E SHIRTZIA ROOUSE IIWOOD cutungs (see p 100 ift spring 1. Cover with plastic but avoid getting too. burnid. Bottom heat is not needed EPIGAEA ROOK greenwood cuttings (see p. 101) in summer without boilom heat I. Separate rooted layers (see p 107) in spring or autumn [ ERICA See pp 110-11 **EUPATORIUM Softwood cuttings** as for Olearia (see p 135) [

Seeds in spring (see p 104) 1 EUPHORNIA Root greenwood stem-tip cuttings (see p 101) in free-draining medium with gentle bottom heat in summer 11. Secus in spring (see p. 104) 11. EURY IPS Root softwood to semiripe cuttings from spring to autumn as for Caryopteris (see

p 121) 1. Sow seeds in spring (see p. 104) at 50-55°F (10-13°C) L ENOCHORDA Softwood curlings in spring as for Syringa (see p. 142 1 Seeds (p 103) in autumn 1 FALLOPIA See Polygonam

(p.138) \* FARSHEDERA Take cuttings as for Hedera (see p 130, 1

DRYANDRA QUERCIFOLIA

### FATSIA

CUTTINGS a larry lent 1 SEEDS IN AUTUMN OF Spring !

The only commonly grown species is the evergreen shrub, Fatsia japonica (syn. Aralia japonica) Cultivars must be increased from cuttings, which are awkward because of their size, but the species is more easily raised from seeds

Prepare semi-ripe cuttings as shown (see right); if necessary, reduce the fohage. Treat as standard cuttings (see p.95), bottom heat of 59-68°F (15-20°C) aids rooting

Sow seeds, extracted in late autumn from ripe black fruits, in pots and cover with vermiculite (see p.104) Germination takes 10-20 days at 59-68°F (15-20°C) Plant out after two years for sizeable plants in three years



### SEMI-RIPE PATSIA CUTTING

Select a young, vigorous, sen crips shoot (here of Fatsia japonica) Remove the top 3-4m (8-10cm), or 3-5 nodes, of the stem by cutting just below a node with clean, sharp pruners. Remove all but the top two leaves and the growing tip: trim off the lower leaves at the base (see inset) bisert the eating so than only the bottom nodes are big ea-

### FORSYTHIA



f to the Northern Gold

SOFTWOOD OR GREENWOOD CUTTINGS from spring to midsummer 1 SEMI-RIPE CUTTINGS from ru doummer to early autumn 🌡 HARDWOOD CUTTINGS TOTAL late autumn to early spring & SEEDS in early spring 1 LAYERING in spring or autumn L

These deciduous shrubs are some of the easiest to root as cuttings. The sprawling Forsythia suspensa self layers in the wild, so layering works well for the species and cultivars. Seeds also germinate readtly. New plants take 18-36 months to reach flowering size

#### CUTTINGS

Softwood or greenwood nodal stem-up and stem cuttings in rooting medium (see pp. 100-01) root in 2-4 weeks Reduce the foliage by up to a half on longer-leaved cultivars. Rooting directly in pots (see p.96) and in a sun tunnel (see p 39) are suitable options

Take semi-ripe cuttings (see p. 95), about 4in (10cm) long if they are to be kept over winter in a cold frame

Leave hardwood cuttings (see p 98) undisturbed until the following autumn, in colder areas, they root more quickly in a cold frame or frost-free greenhouse with bottom heat of 54-68°F (12-20°C)

#### SEEDS

Seeds require about four weeks of chaling (see p 103), in cooler areas, they germinate readily in the same spring if sown in containers in a cold frame

#### LAYERING

Use simple layering (see p. 106) or selflayering (see p 107) to produce new plants; layers root in 6-12 months.

## FREMONTODENDRON

FLANNEL BUSH

SEMI-RIPE CUTTINGS in late summer \$11 HARDWOOD CUTTINGS from late autumn to late winter 11 SEEDS IN Spring !

Taking cuttings of these evergreen or semi-evergreen shrubs (syn. Fremontia) and their cultivars is challenging. but success is possible. Both species germinate readily from seeds New plants reach flowering size in 12 months

#### CUTTINGS

Take 3-41n (8-10cm), nodal stem-tip semi-ripe cuttings (see pp 101 and 95), retain the growing up and only one other leaf. Use hormone rooting compound and a free-draining medium, rockwoolplugs are an excellent alternative. Place in a heated closed case or under opaque plastic with bottom heat of 54-68°F (12-20°C). Regular fungicidal sprays, and medium kept on the dry side, will protect against botrytis. Internodal stem cuttings (see p 94) will root, but less successfully.

Hardwood cuttings (see p 98) will root in a frost-free place, but, for almost guaranteed success, take nodal stem-tip cuttings as above, but from fully ripened wood, and insert in rockwool plugs A vigorous root system should develop in 4-6 weeks. Transplant into 3 &in (9cm) pots immediately after roots are visible

#### SEEDS.

Sow seeds gathered from dry capsules directly into 3%in (9cm) pois (see p.96). to avoid root disturbance. Viable seeds germinate in 30 days with bottom heat of 59-68°F (15-20°C). Water seedlings sparingly at first to control damping off

### **FUCHSIA**



Property and

1 1 1000

SEMI-RIPE CUTTINGS from midsummer to early HARDWOOD CUTTINGS (FOR late autumn to late winter 1 Secos in late winter |

SOFTWOOD CUTTINGS pt area

It is almost impossible for cuttings of the

deciduous and evergreen shrubs and climbers in this genus to fail. Fuchsias can suffer from a range of pests and diseases when grown under cover, so take cuttings from clean, healthy plants only Raising plants from seeds is an alternative for species fuchsias. New plants flower very quickly, usually the following year

#### CUTTINGS

With softwood cuttings (see right and p 100), rooting is almost guaranteed Nodal stem-tip, single-node, and internodal stem cuttings all root within 10-20 days. You can also root them in florist's foam (see right) or rockwool With semi-ripe cuttings (see p.95), the secret to producing a good specimen is to pinch out new growth to a pair of leaves just above the last break of buds

Hardwood cuttings (see p 98) of the vigorous F magellanica and its cultivars root quickly. They can usually be lifted in spring. In cold areas, place the cuttings in a frost-free place

#### SEEDS

Seeds gathered from fleshy fruits and sown in spring and covered with vermiculite (see pp. 103-4) should germinate at 68°F (20°C) in three weeks. Growth at first is slow, but if started early and grown on in warmth the shrub will flower in its first year

### GARDENIA



Gardenia augusta Vertebri

GREENWOOD AND SEMI-RIPE CUTTINGS at any time !
SEEDS at any time !

The shrubby species in this evergreen genus are easily raised from green- and semi-ripe wood (see pp 101 and 95), taken as nodal

stem-tip cuttings. Cuttings resent root disturbance so are best rooted singly in cell trays or pois. They root in 6–8 weeks if kept humid with bottom heat of 68–77°F (20–25°C) and flower in 12–18 months

Seeds germinate readily if sown fresh (see pp. 103-4) and provided with bottom heat of 59-68°F (15-20°C). New plants take up to seven years to flower

### GENISTA BROOM

SOFTWOOD OR GREENWOOD CUTTINGS in early to midsummer \( \)
SEMI-RIPE CUTTINGS in midsummer \( \)
HARDWOOD CUTTINGS from autumn to midwinter \( \)
SEEDS in spring \( \)

These deciduous to evergreen shrubs (syn. Chamaespartium, Echinospartium) flower in their first or second year depending on the cultivar Gentsta hispanica is particularly successful from seeds

#### CUTTINGS

Softwood and greenwood nodal stem-up cuttings (see pp 100-01) of G. tinctoria and its cultivars root in 2-4 weeks

Semi-tipe cuttings (see p.95) taken from G hispanica root reasonably well when material is selected from young

plants producing vigorous growth each season. Take 2–2 Ain (5–7cm) cuttings at the point at which the growth begins to firm and the new foliage narrows. Apply hormone rooting compound and insert in free-draining medium. Keep humid with bottom heat of 59°F (15°C).

Hardwood cuttings (see p 98), 2%—4m (7–10cm) long of G lydia, if taken from well-ripened wood to avoid rot, root well in rockwool plugs. Heel cuttings (see p.96) can be slightly less mature treat them as for semi-ripe cuttings, rooting takes 8–12 weeks

#### SEEDS

Gather seeds from peable pods. Scarify the hard seed coats by sandpapering them and soaking in hot water (see p 102) before sowing in spring Seeds should then germinate in 2–3 weeks

## SOFTWOOD CUTTINGS fo take internodal stem cuttangs

divide a shoot into sections, each with about zon (lent) of stem above and below one set of leaves. These can also be sput vertically to create name cuttings. Purch out lim(2.5cm long growing tips for nodal stem-tip cuttings.





#### FUCHSIA CUTTINGS IN FLORIST'S FOAM



1 Cut a block of florist's fount into 1 in (2.5cm cubes. Soak the cubes in a bowl of water for 10-15 minutes, then place them in a saucer of tray. Use a knitting needle to make a son (1ens) deep hole in the center of each cube. Prepare some stem-tip cuttings of fuchsia (see above)



3 Add water to the sourcer to a depth of Kin (1cm) Label and place the cuttings under a plastic bag, or cover, in bright indirect light at about 59°F (15°C) until rooted (see inset)



2 Insert a cutting into each cube, taking care not to crush the stems. Each cutting should sit with the leaves just above the surface and the base in contact with the bottom of the hale if the hole is too shallow, deepen it with the knitting needle – do not push in the cutting

4 When their roots show through the florist's foam, pot the cuttings singly into Jin (8cm) pots of soilless potting mix. Cover the foam with Ain (5mm) of mix to stop the roots from drying out If exposed, the foam acts as a wick, drawing moisture away from the roots.)



Gently firm

OTHER SHRUBS AND CLIMBING PLANTS FICUS Take greenwood to semi-ripe cuttings at any time as for Hoya (see p. 131) L Air layer anytime (see p. 105) L FORTUNELLA Root semi-ripe cultings in summer (see p 95) with bottom heat 1. Sow seeds in spring (see p. 104) | FOTHERGILLA Take softwood cuttings in early summer as for Humanielis (see p /30) 11. Simple layer (see p /06) 11 GARRYA Take semi-tipe cuttings (see p 95) in summer and again in late autumn. Root in free-draining medium or in rockwool as for free stad when he paids 111 GAU TERA SAN A CONFICENCE P. PREHIVAD Take semi-ripe cuttings in autumn as for Ceanothus (see p 121) 11. Divide suckers see p 101) in spring and autumn 11. Sow seeds as for Rhododendron (see p 13K, 1 GEVERA Semi-ripe cultings as for Oleana. (see p.135) L Seeds in autumn (p.104) L GRAPIOPHYLLUM Semi-ripe culturgs (see p 95) in spring or summer 1. Sow seeds in spring (see p. 104) at 66-75°F (19-24°C) 1 Simple layer (see p 10b) in summer 4. GREVILLEA Heel cuttings (see p. 96) from late summer to late winter 1. Seeds (see p 103) fresh, or soaked at 59°F (15°C) in spring []. Whip graft (see p.109) to avoid rot, for early flower or weeping plant 14. GRISELINIA Take semi-ripe and hardwood cuttings as for Pranus laurocerasus (see p. 138) L. Seeds (see p. 104) in autumn L. GYNURA Take softwood cuttings in spring or semi-ripe in autumn (see pp. 100 and 95) & Use free-draining medium and bottom heat of 68-77°F (20-25°C) HALIMIUM As for Ciscus (see p 122) 1. HALIMODENDRON Take root cuttings in winter as for Celastrus (see p 122) 11. Sow seeds in spring (see p 104) in a frost free place []. Whip-and-tongue graft (see p. 108) onto Caragana arborescens rootstock in late winter !!

### HAMAMELIS WITCH HAZEL

CUTTINGS in spring []
SEEDS in autumn []
LAYERING in spring []
GRAFTING in late summer []

Softwood cuttings of these deciduous shrubs usually overwinter badly, take early nodal stem-tip cuttings (see pp 100–01) as soon as new growth is 2%–4in (7–10cm) long. Bottom heat of 54–68°F (12–20°C) and hormone rooting compound speed rooting, in 6–8 weeks, Keep cuttings just moist and frost free over winter

Place ripe seed capsules in a covered tray they explode to release seeds. The seeds are doubly dormant. Provide three months' warm, then three months' cold, straufication (see p. 103), or, in cold climates, sow fresh seeds and overwinter them in a cold frame (see p. 103). Simple layer (see p. 106) suitable shoots

Spliced-side graft (see p 58) cultivars onto two-year-old, pot-grown seedling rootstocks of Hamamelis virginiana, as low as possible to avoid suckers. Pot two-year-old H virginiana seedlings in early spring as stocks for chip-budding (see below and p 60) and keep watered and in active growth. Transplant in the following autumn to flower in 4–5 years.

#### CHIP BUDDING



I take buds of similar ripeness as on the rootstock in cold regions, these will be at the base of the budstick (here of Hamamelis a intermedia Moontight') Prepare buds with a 2.5mm) stalk and Lain (3cm) of bark



2 Prepare a rootstock (here of H virginiana) and position the bud. If needed, align the bud to the side of the cut on the stock (see inset) so the campiums meet. Bind the bud in place. Keep in humid shade with 68°F (20°C) bottom heat. The bud should take in 4-6 weeks.

### HEBE

SOFTWOOD CUTTINGS from late spring to autumn \$
SEMI-RIPE CUTTINGS from midsummer to late
autumn \$
\$\$

These evergreen shrubs include some small alpine forms. All root well from cuttings, but semi-ripe material is better for many of the smaller-leaved species and cultivars

Softwood cuttings (see below and pp 100-01) root in 3-4 weeks. Use of mist systems or hormone rooting

SOFTWOOD HEBE CUITINGS

Hebes vary widely in size from dwarf to large shriebs. Take nodal stem-up cuttings that are 2-3m (5-8cm) long with



WIRLDAWN' HULKEANA

HI BE



compound can cause cullings to rot

Hebes can suffer from downy mildew

and a leafspot disease; to avoid this, pot

cuttings as soon as rooted, overwinter in

a well-ventilated, frost-free environment,

and water sparingly. Plant out in spring

Take semi-ripe cuttings (see p.95)

from species such as H pimeleoides and

rot at the base then root at the medium

surface. New plants flower in two years.

H. rakaiensis. H. pinguifolia cuttings may

OCHRACEA 'GREAT ORMI

### HEDERA IVY

SOFTWOOD CUTTINGS AT ANY TIME I SEMI-RIPE OR HARDWOOD CUTTINGS from face STEPPER TO LOW CORE I LAYERING AT ANY TIME I

Stems of these evergreen climbers and trailing shrubs root readily in the wild and so are simple to grow from cuttings or by layering. Smaller-leaved species and cultivars may be grafted onto tree try (x fatshedera lizei) to create a standard plant.

#### CUTTINGS

Take single-noded softwood cuttings, leaf-bud, or hardwood cuttings (see pp 97–100) from young stems for trailing plants or adult growth for bushy plants

Longer softwood cuttings of small-leaved Hedera helix cultivars ensure strong growth Root 2–3 cuttings direct in a 3 /m (9cm) pot (see p 96) and keep cool to avoid premature shooting. Rooting takes 4–8 weeks. Cuttings scorch easily

#### LAYERING

Dig up self-layers of H helix and H hibernica, and serpentine layer H colchica and its cultivars (see p. 107)

#### GRAFING

Apical wedge-graft (see p.108) or T-bud (see below) three secons onto the rootstock. T-budding is best done when the secon plant is in full growth. For a full head, pinch back new growth.

#### TOP-WORKING TO CREATE A STANDARD IVY



Prepare a x Fatshedera lizer rootstock, make three stuggered T-cuts around the stem, 3ft (90cm) from the base. Loosen the flaps of bark with the back of a kinde blade



2 As you make each T-cut
slice a bud (see inset)
from a budstick taken from
ripe wood of the Hedera. Slide
the bud into the cut so it fits
snugly, trim off the "tail."



3 Bind the grafted area with grafting tape. Keep in hamid shade until the wounds callus (4–6 weeks). Four weeks after they take, cut back the stem to just above the grafts.

### HIBISCUS



SOFTWOOD OR SEMI-RIPE CUTTINGS from earn to late HARDWOOD CLITTINGS from late autumn to midwinter 🚻 Seeds in spring 1 LAYERING in spring and summer 1 GRAFTING IN WINIER I

syriacus Diana Most of the deciduous and evergreen shrubs in this genus, such as Habiscus rosa sinensis and H syrtacus and their cultivars, root readily from cuttings. Hardwood cuttings are easy to take when pruning evergreen Hibiscus. Less easily rooted cultivars may be layered. Seedlings of H syriacus vary, so they are used mostly as rootstocks. Grafts take readily and in favorable conditions grow quickly enough to be planted out the following autumn or spring. Plants may take three years to flower

#### CUTTINGS

Take standard softwood stem-tip or semi-ripe cuttings (see pp. 100-01 and 95) Bottom heat of 54-68°F (12-20°C) and hormone rooting compound improves success. Pot early cuttings mto 3 /tn (9cm) pots; leave those rooted from midsummer undisturbed over winter Hardwood cuttings (see p 98) of H. syriacus retain the leading bud and root well if frost-free and in deep pots

#### SEEDS

Gather seeds from large, dry capsules Spring-sown seeds (see p. 104) germinate readily. Sow H syriacus in a seedhed for rootstocks the following autumn

#### LAYERING

Air layers (see p.105) of H rosa sincasis cultivars should root in 6-8 weeks

#### GRAFTING

Use scion material up to two years old and apical-wedge graft (see p 108) onto the stock at the union between root and stem. Pot successful grafts into 5 1-7in (14-19cm) pots and grow on in a frost-free place

### HOYA WAX FLOWER

CUTTINGS at any time ! LAYERING at any time |

Plants in this large genus of evergreen shrubby climbers can be increased by nodal, semi-ripe cuttings (see p.95), 3in (8cm) long, which will root in 6-8 weeks at 68°F (20°C) The long lengths of stem are suitable for simple layering (see p 106), from pot to pot il necessary Hoyas may flower quickly, or not for several years

### HYDRANGEA

SOFTWOOD CUTTINGS from late spring to m-dsummer 1 SEMI-RIPE CUTTINGS on midsummer 1 HARDWOOD CUTTINGS IN WINTER ! SEEDS Its spring | LAYERING IN Spring &

Most of the deciduous and evergreen shrubs and chimbers root readily from almost any cutting. Exceptions are climbing Hydrangea anomala subsppetiolaris, which layers easily, and H quercifolia, which will freely germinate from seeds. Some hydrangeas will reach flowering size in their second year

#### CUTTINGS

For most hydrangeas, length determines the type of softwood cutting (see pp.100-01) since the space between nodes varies, but any cutting roots in 2-4 weeks. Pinch out new growth to avoid leggy plants. H. quercifolia and anomala subsp petiolaris need care take 2-4in (5-10cm) nodal stem-tip cuttings. retain only the immature tip Reduce foliage on H quercifolio by up to a half

SPLIT-STEM CLTHNG Use a clean sharp knife or a scalpel to split the stems of softwood and semi upe crit ags

lengthwise to double the amount of cuttings taken



Apply hormone rooting compound Rooting can take up to 12 weeks Root semi-ripe (see p 95) and hardwood cuttings (see p 98), which are good for H. Villosa (syn. H. aspera Villosa Group) and its cultivars (because the hairy leaves and stems are susceptible to rot), in a frost-free place

#### SEEDS

Sow seeds, extracted from dry capsules in containers (see p. 104), cover lightly keep cool and humid at 50°F (10°C)

#### LAVERING

Use serpentine layering (see below and p 107) Rooted layers should be ready to transplant within a year

#### SERPENTINE LAYERING A CLIMBING HYDRANGEA



I beleet a hearthy short than sile or ping aertal mots there of Hydranges an irrain salesp petiolaris) from last year's growth. Mix cannil parts peat and goa outo the son



The Peg down as much of the stem as possible acrial mots downward Lightly bury about 60t (150n) of the stem Keep the layer masse nord new shoots appear, up to a year later

#### OTHER SHRUBS AND CLIMBING PLANTS

HARDENBERGIA Root soft- and greenwood cuttings (see pp 100-01) in summer without bottom heat L. Take semi-ripe cuttings in summer or autumn (see p. 95) 1. Sow seeds as for Clianthus (see p 124) [ HELIANTHEMEN Root greenwood cuttings in summer and autumn (see p. 101) 1. Sow seeds in spring (see p. 104) in a frost-free place 3. New plants need plenty of light HELICHRYSUM Root softwood to semi-ripe cuttings (see pp 100-01 and 95) at any time, avoid getting them too wet & Sow seeds in spring (see p 104) | HELIOTROPIUM Greenwood cuttings in summer (p.101) 1. Semi-ripe cuttings in summer (p 95) & Seeds in spring (p.104) & Hibbertia Root greenwood and semi-ripe

cuttings as for Oleana (see p.135) 1.

HIPPOPHAE Greenwood cuttings (see p 101) in free-draining medium 11. Root cuttings as for Celastrus (see p 122) 14. Sow fresh seeds outdoors in autumn (see p 103) 11 HOHERIA ROOT greenwood and semi-ripe cuttings (see pp 101 and 95) in summer and autumn in free-draining medium 4. Sow seeds in autumn (see p. 104) 1. HOLODISCUS Greenwood cuttings (see p.101) in summer 4. Seeds in autumn (see p 103) 1. Simple layer spring to summer (see p 106) 1 HOVEA Root greenwood to semi-ripe cuttings as for Oleana (see p.135) 4. Sow seeds as for Chanthus (see p.124) 1 HUMULUS Leaf-bad cuttings (p 97) in spring to early summer & Golden forms may scorch, late rooted cuttings overwinter badly Serpentine layer in spring (p.107) 1.

## HYPERICUM St. JOHN'S WORT



SOFTWOOD OR SEMI-RIPS
CUTTINGS from late spring to
carly autumn |
HARDWOOD CUTTINGS from
late autumn to midwanter |
DMISION in spring |
SEEDS in autumn or spring |

Hypericum uncuster

The deciduous and evergreen shrubs in this

genus are easily raised from cuttings or seeds to flower in 2-3 years, hardwood cuttings are best for taller shrubs H calycinum spreads by runners and can be divided

#### CUTTINGS

Softwood and semi-ripe stem cuttings (see pp. 100 and 95), about 2in (5cm) long, with 1-2 pairs of leaves, normally root in 3-6 weeks. For best results, select nonflowering shoots, With softwood cuttings, be careful not to

damage the stem when removing the lower leaves. Direct rooting in pots (see p 96) is an option. For smaller species, such as Hypericum olympicum, cuttings may only be %—1 Ain (2—3cm) in length

If only a few plants are needed, root hardwood cuttings (see p 98) in deep pots; otherwise, root in a sheltered place such as a cold frame or under a sun tunnel (see p.39)

#### DIVISION

Lift clumps of H. calycinum (see p. 101) and replant or pot rooted pieces. This is best done before the new season's growth begins

#### SEEDS

Gather seeds from tipe capsules and sow in autumn in cool climates or in early spring (see p 104); lightly cover with vermiculate. Keep frost-free

## JASMINUM JASMINE



SOFTWOOD OR SEMI-RIPE CUTTINGS IN Spring and summer !

HAROWOOD CUTTINGS IN WINTER!

LAYERING IT Spring !

Jusminum 6

These deciduous and evergreen shrubs and climbers are relatively

of Jasminum officinale and f. nudiflorum are best from hardwood. Layering is an option, especially for species that produce aerial roots along the stems it usually takes three years to obtain a good-sized flowering plant

#### **CUTTINGS**

Softwood and semi-ripe cuttings
(see pp 100 and 95) can be internodal
to reduce the length of the cuttings.
Remove part of the compound leaf to
reduce the risk of botrytis. Hormone
rooting compound ands rooting, which
usually takes about four weeks. Cuttings
rooted early with sturdy topgrowth are
likely to overwinter better in cooler
climates. Always take a few extra
cuttings to avoid disappointment.

Take standard hardwood cuttings (see pp. 98–9) In cold areas, root in a sheltered place such as in a cold frame or in deep pots left over winter in a frost-free greenhouse

#### LAYERING

Select shoots with roots forming along their length and simple layer them (see p.106). A good root system should form within 12 months. Then sever from the parent plant and pot up or plant out

### KALMIA MOUNTAIN LAUREL

GREENWOOD CUTTINGS in summer [1] HAROWOOD CUTTINGS in inclusive [1] SEEDS in winter to early spring [1] LAYERING in spring [

Cuttings of these evergreen shrubs can be challenging and, although seeds germinate readily, seedlings need care Layering is the most rehable option New plants take up to five years to flower well

#### **CUTTINGS**

Wound greenwood cuttings (see p.101) on both sides of the stem, then treat as rhododendrons (see p.138). Rooting is slow. Try hardwood cuttings (see p.98).

#### SEEDS

Surface-sow seeds as for rhododendrons (see p. 138). Seedlings require shade and a low-nutrient soil mix because they become scorched easily.

#### LAYERING

Simple layering (see p.106) produces rooted plants in 12 months and plants for the garden in another two years

## KOLKWITZIA BEAUTY BUSH

SOFTWOOD AND GREENWOOD CUTTINGS in late spring or early summer \( \frac{1}{4} \)

Kolkwitzia amabilis, a deciduous shrub roots easily from cuttings to flower in three years. Treat the cuttings as for Philadelphus (see p 136). Avoid water shoots, and make the cuttings at least three nodes in length to increase the number of new shoots and improve success in overwintering

### LAPAGERIA

CHILEAN BELLFLOWER

SEEOS in spring \( \)
LAYERING in spring and autumn \( \)

The best way to propagate this single species of evergreen climber, Lapageria rosea and its cultivars, is by layering. Shoots can be either simple or serpentine layered (see pp 106–7). Semi-ripe or basal cuttings are sometimes recommended, but where marginally hardy they are very reluctant to root and, if they do, rarely grow successfully even in warm climates.

Soak the seeds for 48 hours prior to sowing individually into 3in (8cm) pots (see pp. 103–4). Cover with Ain (1cm) of vermiculate and germinate at 59–68°F (15–20°C). New plants take 2–3 years to reach flowering size.

### LAVANDULA LAVENDER

SOFTWOOD OR SEMI-RIPE CUTTINGS from early summer to autumn \$\frac{1}{4}\$. HARDWOOD CUTTINGS from late autumn to late winter \$\frac{1}{4}\$. SEEDS in spring \$\frac{1}{4}\$. LAYERING in spring \$\frac{1}{4}\$.

Often, these evergreen shrubs and subshrubs are so full of flower after the first one or two years that there is insufficient suitable new growth for cuttings, which often readily succumb to botrytis. Seed-raised species and cultivars are of variable habit and flower color. Layering is an option for older, leggy plants that are slow to produce new growth

#### Cuttings

Take 2%—3th (6—8cm) softwood or semiripe cuttings (see pp. 100 and 95) from young plants in early to midsummer trim below a node, and strip off the bottom 1 %th (3cm) of foliage. Apply hormone rooting compound and insert in free-draining medium. Early-summer



### LAVATERA MALLOW

SOFTWOOD OR GREENWOOD CUTTINGS from spring to autumn ‡

Although it is possible to root cuttings of the deciduous and evergreen shrubs and subshrubs in this genus throughout the year, those taken before flower buds form from soft- and greenwood root most quickly and surely.

The length between nodes can be quite great, and mallows will root from internodal cuttings, so take cuttings (see pp 100-1) at a set length of 2%-3in (6-8cm), regardless of whether it means trimming above or below a node. This will ensure that the new plants are not leggy. Rooting takes 2-4 weeks. Mailow are also prime candidates for rooting directly in pois (see p 96). New plants flower in 1-2 years.

cuttings root reasonably under mist or unheated opaque plastic. Air cuttings regularly and spray with fungicide Rooting takes 4–8 weeks. Take semi-npe cuttings with a heel (see p.96) and root in a frost-free place.

Hardwood cuttings are taken as for semi-ripe cuttings, but after flowering and preferably from new flushes of growth (see below). In winter, they may take three months to root. Keep frost-

free to prevent premature shooting. If his occurs, pinch new growth back to just above the original cutting to prevent

rot or aphid attack

#### SEED5

Sow the seeds, gathered from dry seedheads, after four weeks of cold stratification (see pp 103-4)

#### LAYERING

Use mounding (see p 290) to obtain goodsized plants by the next spring Plant them quite deeply to avoid legginess



CUTTING BACK FLOWFRING SHOOTS OF LAVENDER Hardwood cuttings of lavender are best taken from new flashes of growth after blooming Encourage formation of new shoots by trimming off all the flowering stems as their cotar lades. Take care not to cut back the shrub too hard, because lavenders do not break readity from old wood

### LIGUSTRUM PRIVET

Softwood on SEMI-RIPE CUTTINGS from early to midsummer # HARDWOOD CUTTINGS from fate autumn to midwinter # SEEDS in late autumn or early spring # LAYERING in spring or autumn #

This genus includes deciduous and evergreen shrubs. Privet is often grown as a hedge, and the clippings make good cuttings. It takes three years to grow a good-sized plant

Take nodal softwood and semi-ripe cuttings (see pp. 100 and 95), 2%—4in (7—10cm) long, retain the top two pairs of leaves. Rooting takes 3—6 weeks. They can be rooted directly in pots (see p. 96)

Root hardwood cuttings (see pp 98–9) either in open ground or in a frost-free place. Do not worry if foliage drops, new leaves will appear in spring. Ligustrum produces 3ft (1m) or more of growth when young and vigorous, so it is possible to take very large cuttings (see below) to produce mature plants ready to go in the garden the following autumn, 1–2 years sooner than usual

All privets may be simple layered (see p. 106). Gather seeds from ripe betries and sow fresh (see p. 104) in late autumn. Dry seeds germinate more uniformly if given 6–8 weeks of cold stratification (see p. 103) in spring

#### TAKING LARGE HARDWOOD CUTTINGS OF PRIVET



Remove 2ft (60cm) long ripe shoots (here of Ligustrum ovalifolium), cutting at the base of the new growth, just below a node



2 from off the soft tips and the fe bage to m the bottom half of the stems, cut all the shoots to a uniform length (see inset). Remove a sliver of bark, I sin (3.5cm) long, from the base of each cutting with a clear hinfe or pruner blade. Space the cuttings in a slit trench 4in (10cm) apart so that the foliage is just clear of the soil. Firm in, water, and tabe!

#### OTHER SHRUBS AND CLIMBING PLANTS

HYPOXALYMMA Take semi-ripe cuttings in summer (see p. 95) 1. Surface-sow seeds in spring (sec p 104) | Hyssorus Take softwood to semi-ripe cuttings from spring to autumn (see pp 100-1 and 95) [[] ITEA Root evergreen species from nodal greenwood and semi-ripe cuttings as for lex see p 81); deciduous species from softwood and greenwood cuttings (see pp. 100-1) [ Surface-sow seeds in spring (see p 104) IXORA Root semi-ripe cuttings (see p 95) in summer with bottom heat 11 KENNEDIA Seeds an spring as for Chanthus (see p. 124) 1. KERRIA Divide suckers (sec p 101) & Soft- to hardwood cuttings as for Forsythia (see p. 128) 1 **LANJANA** Take greenwood and semi-ripe internodal

cuttings (see pp. 101 and

95) in summer and autumn 1.

Cuttings root well in rockwool plags LESTOSPERMUM Root semi-ripe cuttings as for Pittosporum (see p.137) L Sow seeds in autumn or spring (see p 104) 1 LESPEDEZA Take softwood and greenwood cuttings as for Caryopteris (see p. 121) Sow seeds in autumn (see p.103), or store and sow in spring as for Chanthus (see p. 124) 1. LEUCOTHOE Root greenwood and semi-ripe cuttings from midsummer to midwinter as for evergreen azaleas (see Rhododendron, p. 138) 1. Sow seeds as for Rhododendron 1. LEYCESTERIA Piace hardwood cuttings in a prepared bed in a cool, frost-free place in autumn to winter (see p. 98) 1. Seeds in autumn (see p.103) 1.

LITHODORA Take greenwood nodal stem-tip cuttings from summer to early autumn (see p.101) [4]. Air foliage regularly.

LEYCESTERIA FORMOSA

### LONICERA HONEYSUCKLE



SOFTWOOD, SEMI-RIPE OR LEAF-BUD CUTTINGS from late spring to late summer 1. HARDWOOD CUTTINGS IF TO rate autumn to midwinter I LAVERING in spring 1 SEEDS in autumn or spring |

LORGICAL Kh Bront

Honeysuckles may be evergreen or deciduous

Both shrubs and climbers may be grown from cuttings, and the climbers also respond well to layering. Flowering plants may be raised in three years

#### CUTTINGS

Softwood and semi-ripe internodal stem-tip or stem cuttings (see pp. 100) and 95) root in four weeks. Take cuttings 17-2m (3-5cm) long of climbers, such as Lonicera japonica, but 2/-3in (6-8cm) long of closer-noded shrubs

(such as L. pileata). Take care to use material free from aphids and powders mildew. Do not crowd the cuttings, which encourages bottvus. Semi-ripe cuttings of L. pileata and L. nuida root well if kept frost free You can also take leaf-bud cuttings (see p 97). Take standard hardwood cuttings (see p 98) 8-12m (20-30cm) cuttings of evergreens produce good-sized plants by the next autumn

#### SEEDS

Seeds need cold to germinate; sow seeds extracted from berries fresh in autumn or refrigerate in moist peat for three months before sowing (see pp. 103-4)

#### LAYERING

Serpentine layer (see p 107) suitable shoots, they take 6-12 months to root

### MAGNOLIA



As a plat P. In

SEMI-RIPE CUTTINGS Inom take Soft fact to autumn 11 SOFTWOOD OR GREENWOOD CUTTINGS in fall spring to early summer 11. SEEDS in aurumn and spring 11 SIMPLE CAYERING IN Spring 1 AIR LAYERING In Jutunin 11 GRAFTING in late sure pur

autumn or spring l

Many deciduous shrubs in this genus may be increased from nodal stem-tip cuttings of soft- or greenwood, in the same way as for tree magnohas (see p.83). At the base of each cutting make a light wound, no more than %in (2cm) long. Take 4-6in (10-15cm) semi-npe cuttings of evergreen shrubs and treat

as softwood cuttings, they root slowly inautumn and into winter. Sow the doubly dormant seeds as for tree magnolias

Simple layer magnolias in spring (see p. 106), and sever the rooted layers in the following spring. Air layering (see p 105) in autumn works well on the slower-growing species such as M stellata

For the gardener, grafting is often the best way to propagate magnolias. For smaller shrubs, use seed-raised M. kobus. or M x soulangeand grown from cuttings as rootstocks. Spliced side-vencer graft (see p 109) in autumn and early to midspring Chip budding (see p 60) in late summer makes economical use of material Plants mature in 4-5 years

### MONSTERA SWISS CHEESE PLANT

LEAF-BUD OR STEM CUTTINGS as any time ! LAYERING at any time 1

All of these evergreen, often epiphytic climbers produce aerial roots, making them suitable for layering, but cuttings also produce good results. It takes two years to obtain mature plants

Take leaf-bud (see right) or stem (see below) cuttings, normally two nodes in length, and place in free-draining medium in a humid environment with 68-77°F (20-25°C) bottom heat. The leaf may be rolled up to stop the cutting from toppling. If you have more than one stem cutting, space them lin-(2 5cm) apart in the tray Stem cuttings may also be inserted vertically in pots Rooting takes 4-8 weeks Protect new foliage from hot sun to prevent scorch

To simple layer (see p. 106), pin down a long shoot of the new growth into soil or an adjacent container filled with free-

> draining medium. Layers root (airly quickly (3-6 months). but sever new plants only once they are well established



STEM CUTTING OF SWISS CHEESE PLANT Choose a voing stem that is just forming gerial. roots. Cut a 2m (5cm) section as for leaf bud cidings (see right). but a tray with solliess rooting medium. Press in the cutting so that it is half buried, with the bud appearnost

## MAHONIA OREGON GRAPEHOLLY

LEAF-BUD OR SEMI-RIPE CUTTINGS From endsammer to autumn 1 HARDWOOD CUTTINGS in winter 1 Division in spring and autumn ! SEEDS in autumn 1

Semi-ripe or hardwood cuttings from these evergreen shrubs are treated in similar ways. Wood taken once the first flush of growth has matured will root. but later cuttings root better Plants flower after three years

Prepare cuttings as leaf-bud cuttings (see right and p 97) Mahonias have quite short internodal growth, so a cutting can have two or more nodes. Make a small wound, about %in (1cm) long, on one side of the stem, reduce the compound leaf to 2-3 pairs of leaflets. Root in freedraining medium, bottom heat of 59-68°F (15-20°C) improves rooting

Mahonias can grow 12in (30cm) or more in a year, so several hardwood cuttings (see p 98) can be made from one stem Divide clumping species such as M aquifolium when not in active growth

(see p. 148) Seeds often cross-pollmate, as do some taller M aquifolium hybrids with M. pinnata, but seedlings are suli worthwhile from homesummer and clean and wash the seeds

gathered seeds. Gather ripe fruits in early Culting thoroughly before sowing (see p. 104)

Planded. soft tip and Experience as Compound leaf MAIIONIA LEAF-BUD CUTTINGS Select a shoot of this season's growth there of Mahonia japonica). Remove the soft tip and top pair of leaves. Cut the stem into 1-2in (2.5-5 cm) internodal cuttings (see inset) lake off att but the top leaves and

trim those, cutting above a leaflet

#### MONSTERA LEAF-BUD CUTTING



I Scient a hearthy, not quite mature leaf them
of Monstera deactosa Variegata) with a
good biid in the leaf axil. Cut straight across the
stem tast above the biid and about (in (2.5cm)
below the note using a clean, sharp limit



2 (2 fem) bigger in dian ever than the stem bill with soilless rooting n entain. Insert the stem vertically. Support the cutting with split stakes or roll up the leaf, stake it, and secure with a twest tie. Water and tabel.

## NERIUM OLEANDER, ROSE BAY

GREENWOOD OR SEMI-RIPE CUTTINGS from late spring to early autumn 1
SEEDS in spring 1
LAYERING at any time 1

Nerium oleander is an evergreen shrub
To produce a flowering plant in two
years, root 3in (8cm) greenwood or
semi-ripe cuttings (see pp. 101 and 95)
tirect in pots (see p. 96) in a humid
environment. Bottom heat of 54–68°F
(12–20°C) speeds rooting, in 3–6 weeks
Cuttings also root in water (see p. 156)
Remove tips for bushy plants

Gather seeds from beanlike pods in autumn. Sow in spring (see p 104) at 61°F (16°C) to germinate in two weeks Oleanders hybridize readily (see p 21) Air or simple layering (see pp.105–6) produces a large plant but requires more time and effort than do cuttings

### OLEARIA DAISY BUSH

SOFTWOOD OR SEMI-RIPE CUTTINGS from summer to nuturn ##
HAROWOOD CUTTINGS IN WARLER #

Among the evergreen shrubs in this genus, Oleana stellulata and similar weaker-growing species root reasonably well from softwood cuttings (see p. 100) in free-draining medium in humid conditions, such as under plastic. Pot cuttings rooted early in the year, when hardened off, into 3%in (9cm) pots to avoid straggly plants. With hybrids such as O, x haastii and O, x scilloniensis, finding nonflowering shoots may be difficult, 2%-3in (6-8cm) semi-ripe

cuttings (see p.95) root best. Leave the growing tips if possible, to prevent botrytis from setting in Oleanas also root well in rockwool (see p.35)

Hardwood cuttings (see p 98) of O macrodonta root well. Make sure that the wood is fully mature at the base and root in a humid frost free place. If placed in a greenhouse, cover with plastic but do not provide bottom heat, which encourages rot. Large cuttings, 8–12 in (20–30 cm) long, will produce large plants ready to be planted in the garden the following autumn. New plants flower in 3–4 years.

#### OTHER SHRUBS AND CLIMBING PLANTS

**EUPINUS** Take softwood and greenwood basal cuttings (see pp 100-1) in spring 1 Too. much humidity will not the cuttings. Sow seeds in spring as for Chanthus (see p. 124) 1. LYONIA Root greenwood and semi-ripe cuttings as for evergreen agaleas (see Rhododendron p. 138) L Sow seeds as for Rhododendron 1 MANDEVILLA Root softwood and greenwood cuttings (see pp 100-1) in early summer with bottom hear of 68-77°F (20-25°C) [ Now seeds in early spring (see p 104) with bottom hear of 68-77% (20-25%) 1 MANETHA Take softwood stem-up cuttings (see p. 100-1) in late spring or summer or schillings (see p 95) 4. Sow seeds in spring (see p 104) at 55-64°F (13-18°C) [ MEDISILLA. Root greenwood cuttings (see p 101) in spring and summer, with humidity and 68-77°F (20-25°C) bottom heat 4. Sow seeds in spring (see p 104) at 66-75°1. (19-24°C) L. Air layer any time (see p 105) L. MEETAVITIUS Take basal softwood cuttings. (see p 100) in spring when new growth is no more than 6th (15cm) long 1. Divide clumps in early spring (see p 101). Sow seeds in spring as for Abuttlon (see p 118) 1. Mesziesia. Root greenwood cuttings in summer as for evergreen azaleas (see Rhododendron, p. 138) L. Sow seeds as for Rhododendron (see p. 138) 1 Metitositi kos. Take semi-ripe cuttings as for evergreen Ceanothus (see p 121) 11. Surfacesow seeds at 57°F (14°C) in spring (p f04) 4 MINOSA Root nodal softwood cuttings (see p 100) in late spring L Sow seeds as for Clianthus (see p. 124) L MINICLUS Take softwood to semi-ripe cuttings (see pp. 100-1 and 95) 1. Once rooted, harden off quickly, since they are prone to rot. Surface-sow seeds in early spring (see p. 104) 1 MITCHELLA Take semi-ripe cuttings (see p 95) from late summer to autumn 1. Sow seeds in autumn (see p. 103) 1. Myrica Root nodal greenwood cuttings (see p 101) in early to midsummer with

bottom heat 1. Take root cuttings as for Celastrus (see p. 122) 1. Sow seeds in autumn (see p. 103) 1. Simple layer (see p. 105) 1 MyRfUs Root seint-ripe to hardwood currings as for Pittosporum (see p.137) II For small leaved species, which are more difficult to root, place %-%m (1-2cm) of fine grit on top of the medium. Sow seeds in autumn or spring (see pp 103-4) 11 NANDINA Take nodal greenwood cuttings (see p 101) in summer 4. Select wood just at the point at which the stem is darkening Divide suckers (see p 101) 1, Sow seeds in autumn (see p. 103) [ NULLIA Root softwood to semi-ripe stemcuttings in summer as for Philadelphia (see p 136) 1. Sow seeds in autumn (see p 103) 1. OFMERIA (5yn. Osmaronia). Take nodasoftwood and greenwood cuttings in late. spring as for Amelanchier (see p 118) 1. Divide suckers as for Amelanchier (see p.118) 1. Sow seeds in autumn (see p.103) 1. OSMASTRUS Root semi-ripe andal stem-np cuttings (see p 95 and 101) from late summer to winter []. Where possible take with a heel. Insert in free-draining medium or mckwool plugs with bottom heat. Sow seeds in containers in autumn (see p. 103) and leave in a frost-free place 11 OSTEOSPERMUM Take softwood to semi-ripe cuttings (see pp 100-1 and 95) at any time 1 Sow seeds in spring (see p 104) 1. OZOTHAMNUS Semi-ripe cuttings from late summer to winter as Pidomos (see p 137) 11 Cuttings are prone to rotting off. Sow seeds in autumn (see p. 103) in containers in a frost-free place II. PACHYSTACIN'S ROOL softwood and greenwood nodal stemtip cuttings (see pp 100-1) in summer 1.

MIMULUS AURANTIACUS

### PAEONIA PEONY



Not we Elisabeth'

SEEDS ist summer 🕌 GRAFTING in late summer 🛔

This discussion refers to the shrubby deciduous tree peonies Species come true from seeds but take several the med suffrationsal years to flower. Grafting

is the best option Plants flower in 2-3 years.

#### SEEDS

Sow seeds fresh (see p.103) in pots and provide two periods of chilling, such as two cold winters, with warmth between Seeds are doubly dormant (roots emerge in the first year and seed leaves in the second) Guard against mice: they love the seeds. (See also Perennials, p 204)

#### GRAFTING

A scion and rootstock of the same species avoids suckering; however, Paconia lactiflora and P officinalis stocks are often used. Take a piece of root about 4in (10cm) long and 1/2-7/in (1-1 5cm) thick for a stock. Many stocks can be taken from one plant, and then discard the plant. Prepare a scion from a Lain (4cm) single leaf-bud cutting with a bud in the axil. Make the cut in the stock to a depth of 14-15in (3-4cm) Proceed as for a standard apical-wedge graft (see p 108)

In autumn, the grafts should be ready for potting. Grow on for a year in a frost-free place before planting out, make sure the union is underground to encourage the scion to root

### PARTHENOCISSUS VIRGINIA CREEPER, BOSTON IVY

SOFTWOOD OR SEMI-RIPE CUTTINGS from spring CONTRACTOR AND ADDRESS. HARDWOOD CUTTINGS AND LE 1 Seeca in autumn and spring 11 LAYERING IS Spring 1

Cuttings of these vigorous, deciduous climbers can be a little awkward. Plants mature in three years

#### CUTTINGS

Softwood cuttings (see p 100) may rot, semi-ripe ones (see p 95) root better but may fail to overwinter Rooting takes 3-5 weeks. Cuttings of Parthenocissus tricuspidata should have several nodes to give them more overwintering buds from which to shoot away. Internodal cuttings 2%-3in (6-8cm) long of P quinque/olia have only one node. but once rooted they grow away more readily. Cuttings from up to three-yearold hardwood (see p.98) root well in a frost-free place. Bottom heat can be used if the topgrowths remain cool, they are prone to premature bud burst.

#### SEEDS

Chill seeds extracted from black, fleshy fruit for two months, by sowing fresh in autumn or cold stratifying (see pp 103-4).

#### LAYERING

Many plants form aerial roots along the shoots; serpentine layer (see p.107) one such shoot to obtain several plants



PARTHE SOCISSUS TRICL SPIDATA 'LOWII' Softwood or semi-ripe cuttings of this and other addivars of Boston by should have at least 3-4 codes: larger carrings overwinter more easily

## PHILODENDRON

he spring, pot on carriers occu-

Aureus') rooted deectly in pots,

of Philadelphus coronarius

or plant out in a nursery bed.

SOFTWOOD OR SEMI-RIPE CUTTINGS at any line ! SEEDS when ripe 1 LAYERING at any time I

The evergreen, often epiphytic climbing shrubs in this genus naturally root from their stems, so they are easy to grow from cuttings or layers if kept warm and humid

Leaf-bud, stem-tip, and stem cuttings (see pp 95-101) of soft- or semi-ripe wood, up to 4in (10cm) long, are al. suitable (see below). The type of cutting is determined by the spacing between the nodes, which varies greatly. Rooting takes 4-6 weeks at 70-77°F (21-25°C) Cuttings require indirect light and misting during very warm weather

## PASSIFLORA PASSIONFLOWER, GRANADILLA



Ame hyst

SOFTWOOD OR SEMI-RIPE CUTTINGS from spring to late. stammer 1 SEEDS at any time 1 LAYERING IN Spring |

The mainly evergreen climbing plants in this genus are very easily increased from any

type of softwood or semi-ripe cutting. including nodal stem-tip (see p.101), leaf-bud (see p. 97), and semi-ripe stem (see p.95) cuttings. Rooting takes 3-4 weeks in a humid environment, but do not transplant until spring.

Cuttings may be rooted directly in pots (see p 96)

Ferment the seeds to kill fusarium disease: store tipe fruits for 14 days, mash, and leave pulp in warm place for 3 days. Clean seeds in a sieve under running water, then dry. Prior to sowing (see pp. 103-4) at 68-77°F (20-25°C), soak the seeds for 24 hours in hot water to soften their hard coats. They should then germinate readily

Very long shoots suitable for serpentine layering (see p. 107) are produced every year. New plants fruit and flower freely after 2-3 years

## **PHILADELPHUS**

MOCK ORANGE

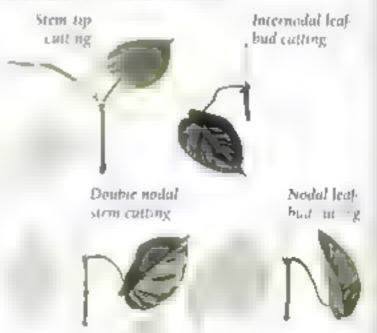
SOFTWOOD OR SEMI-RIPE CUTTINGS from Jave. spring to midsummer | HAROWOOD CUTTINGS IN WINTER ! SEEDS in late winter or spring \$

Take softwood or semi-ripe, nodal stemtip and stem cuttings (see pp 100 and 95) of these deciduous shrubs. The cuttings should be two internodes or about 3in (8cm) long, avoid thick, pithy water shoots and look out for tips distorted by aphids. Root semi-ripe cuttings in a tray or directly in pots (see pp 95-6). Rooting takes 4-6 weeks. Root hardwood cuttings (see p 98) in a frostfree place or on a heated bench

Seeds germinate more freely if given 6-8 weeks chilling (see p. 103) before sowing. Do not let seeds dry out

SEMI-RIPE CUTTINGS

#### TYPES OF CUTTING



### **PHLOMIS**

SEMI-RIPE OR HAROWOOD CUTTINGS from migsa to not to mady into \$4.

SEEOS in spring \$

As with many gray-foliaged plants, cuttings of the evergreen shrubs and subshrubs in this genus are prone to rot if kept too wet, seeds of species germinate readily. Plants should mature in two years

#### CUTTINGS

Take nodal stem-tip semi-ripe or hardwood cuttings (see pp. 95 and 98), 4in (10cm) long, from nonflowering, current season's growth. Insert in free-draining medium and place under plastic. It is easy to kill cuttings if the medium and environment are too damp. Avoid bottom heat, which creates condensation that drips onto leaves, encouraging botrytis. Air the cuttings at least three times a week for 5–10 minutes. Phiomis root excellently under cover in the garden. Rooting takes 4–12 weeks.

#### SEEDS

Sow seeds in spring (see p 104) and cover with vermiculite. Germinate in 2–3 weeks at 59–68°F (15–20°C)

Extract seeds of species from ripe berries and sow immediately (see pp 103-4) with bottom heat of 68-77°F (20-25°C)

Air layering (see below and p 105), and simple layering (see p 106) provide large new plants in 12–18 months. Seeds or cuttings provide a good-sized plant in another year or so



Wound the stem when are layering a philodendron by harte ringing the chosen shoot. Score two parallel cuts, about %in (1cm) apart, around the stem. Take care not to cut too deeply into the pith. Then peel off the

ring of bark to reveal the wood (see inset)

### **PIERIS**



GREENWOOD OR SEM-RIPE
CUTTINGS from late spring to
autumn | |
SEEDS in late winter or
spring |
LAYERING in spring |

P as Sports It can be hard to find good cutting material on these evergreen

shrubs but is worth the effort, because only species are best raised from seeds. Plants flower in three years

#### CUITINGS

Once the new foliage loses its red or pink tinge, take thin nodal greenwood cuttings (see p 101), up to 3in (8cm) long, from a vigorous plant. Remove the tips and retain 4–5 leaves. Reduce larger leaves by half. With hormone rooting compound, free-draining, low-nutrient medium, and 54–59°F (12–15°C) bottom heat, rooting takes 6–8 weeks Make ½–Xin (1–2cm) wounds on semi-ripe cuttings (see p.95)

#### SHEDS

Surface-sow seeds (see p 104), keep motst at 59°F (15°C). Seedlings grow slowly and are prone to scorch

#### LAYERING

Simple layer (see p 106) in spring, but air layer (see p 105) at any time

### **PITTOSPORUM**



du espoyani Garnetti SEMI-RIPE CUTTINGS IN autumn 11
SEEDS in late winter 1
LAYERING in early spring 1
GRAFTING in late winter 1

The evergreen shrubs in this genus have more than one flush of growth, so it is easy

to confuse an earlier flush with old wood. Take 27-3in (6-8cm) semi-ripe cuttings (see p 95) from current season's growth. Cuttings can rot off at the base but if inserted through a ¼in (2cm) layer of sharp sand on free-draining medium, they often root higher up the stem Large-leaved and green species and cultivars root more easily. Rooting takes 8-12 weeks at 54-68°F (12-20°C) If leaf drop occurs, discard the cuttings and take a second batch

Gather the sticky seeds when the capsules split, wash in soapy water, and sow (see p.104) at 59°F (15°C). Seedlings may be planted out after one season. Increase suitable shoots by air and simple layering (see pp.105–6).

Whip graft (see p 109) or spliced side graft (see p 58) onto a one-year-old P tenuifolium seedling rootstock. Under plastic, the union calluses in six weeks at this point, harden off and cut back the stock. Expect 12m (30cm) of growth in a year in sheltered conditions.

#### OTHER SHRUBS AND CLIMBING PLANTS

PARABI-BE Root greenwood cuttings in late spring and early summer in free-draining medium as for Hebe (see p.130). Sow seeds in spring (see p.104) in a frost-free place & Paraottopsis Root greenwood cuttings as for Magnolia (see p.134) in early summer & Sow seeds as for Hamamelis (see p.130). & Pensit sion. Take nodal softwood to semi-npe cuttings (see pp.100 and 95) from spring to autumn & Sow seeds in autumn or spring (see pp.103—4). & Pentas. Take softwood cuttings (see p.100).

PENTAS Take softwood cuttings (see p 100) at any time 1. Sow seeds in spring (see p 104) at 61-64°F (16-18°C) 1

PEROVSKIA Root nodal stem cuttings in spring before flowers form, as for Caryoptens (see p. 121) J. Keep hardwood cuitings in winter frost-free (see p. 98) J. PETREA Semi-ripe cuttings (see p. 95) in summer with bottom heat of 64°F (18°C) J. Simple or air layer (pp. 105–6) in late winter J. Philageria. Layer as Lapageria (see p. 132) J. Photinia. Root nodal greenwood and semi-ripe cuttings (see pp. 101 and 95) in free draining medium from summer to winter J. They root well in rockwool plugs and with high levels of rooting hormone. Sow seeds in spring (see p. 104) J.

Pirettius Take softwood basal cuttings in spring and nodal greenwood cuttings up to autumn (ser pp 100-1) 1. Sow seeds in spring (see p. 104) at 50-59°F (10-15°C, 1 PHYLLODOCE As for heaths (see pp 110-11) 4 Physocangus Softwood to semi-ripe cuttings from late spring to late summer as for Caryopteris (see p.121) 1. Seeds in spring (see p 104) in a frost-free place 1. PILEOSTEGIA Semi-ripe cuttings in summer and autumn as for Escallanta (see p.127) 1. Simple or serpentine layer (see pp 106-7) | PIPER Greenwood cuttings (see p. 101) in summer at 68-77°F (20-25°C) 1. Seeds in spring (see p 104) at 68-77°F (20-25°C) | PIPTANTHUS Seeds as Chanthus (see p. 124) 1 PISONIA Take greenwood to semi-ripe cuttings (see pp 101 and 95) in summer 1. Sow seeds in spring (see p. 104) J. Air layer (see p 105) in spring 1. PLUMBAGO Take softwood to semi-ripe stem cuttings (see pp. 100-101 and 95) from spring to autumn 1. Seeds in spring (see p 104) 1. Polygata Root nodal softwood to semi-ripe cuttings (see pp. 100-1 and 95) in spring and summer 1 Sow seeds of hardier species in autumn; sow seeds of tender species in spring (see p. 104) 1.

### POLYGONUM RUSSIAN VINE, MILE-A-MINUTE PLANT

rolds, hourcant

SOFTWOOD OR SEMI-RIPE CUTTINGS from late spring to late summer 11 HARDWOOD CUTTINGS III WIBSET ROOT CUTTINGS IN WINIER !

These vigorous, deciduous climbers (syn. Fallopia) are very vigorous growers, yet

softwood and semi-ripe cuttings (see pp 100 and 95) are surprisingly difficult to root. Some rot, while others fail to overwinter in colder climates. Take internodal cuttings no more than 2 am (6cm) long. Rooting takes 2-4 weeks and growth is slow. New plants take three years to reach flowering size

With hardwood cuttings (see p 98), untangling the twisted mass of mature stems is usually the hardest part. They root well in deep pots or trays in a frost-free place such as a greenhouse If shoots appear before roots are well developed, cover them with fleece to protect them from being scorched by the sun Cuttings potted singly in 5/-7m (14-19cm) pots will be ready to plant in autumn. Root cuttings may be taken as for Celastrus (see p 122)

## POTENTILLA CINQUEFOIL

GREENWOOD TO SEMI-RIPE CUTTINGS (rom late spring to late surrough HARDWOOD CUTTINGS IN WIDIET SEEDS in automa or spring l

The deciduous shrubs in this genus (syn, Comarum) are easy to root from greenwood and semi-ripe stem cuttings (see pp 101 and 95), but they must not be allowed to dry out because the young foliage scorches easily

Take cuttings 2-2½in (5-7cm) long. and pinch out the growing tips if they are still soft. Rooting takes about three weeks. Nodal and internodal cuttings. do equally well. Rooting directly in pots (see p 96) and under the protection of a sun tunnel (see p.39) are other options Watch out for powdery mildew in spring and spider mite at the end of summer if raising plants under glass

Similarly sized cuttings may be taken from hardwood (see p.98). These may be slightly larger than standard length for the more vigorous cultivars of Potentitla fraticosa, such as 'Gold Drop' and Klondike' The cuttings root well in a cold frame or in a deep container on a heated bed in a frost-free greenhouse

Shrubby potentillas may be grown from seeds (see p 104) but may take longer to flower, usually in two years, and produce variable offspring

### PRUNUS ORNAMENTAL CHERRY

SOFTWOOD CUTTINGS in late spring and early

SEMI-RIPE CUTTINGS from fate summer to autumn 1 HARDWOOD CUTTINGS from late autumn to fate SEE08 in autumn or spring 11

There is a wide range of deciduous and evergreen shrubs in this genus Flowering shrubs such as Prunus tenella and P glandulosa root in 4-6 weeks from softwood basal cuttings (see p 100) taken from new 2 hin (6cm) shoots as

the flowers fade. Semi-ripe and hardwood cuttings (see pp 95 and 98) of the evergreen laurels, P laurocerasus and P lusitarica, root prodigiously if kept frost-free and humid. Reduce large leaves by half. Rooted cuttings may be potted in 5/-7m (14-19cm) pots in late winter and planted out the following autumn

Gather seeds from ripe fruits. They need 2-3 months' cold to germinate sow fresh in autumn or stratify in moist peat before spring sowing (see pp. 103-4)

### PYRACANTHA FIRETHORN

GREENWOOD OR SEMI-RIPE CUTTINGS ITOM midsummer to early automn 1 HARDWOOD CUTTINGS from late autumn to midwinter II SEEDS in autumn or spring 11

Several cuttings may be taken from one new shoot of the evergreen shrubs in this genus. In two or three years they will flower and fruit

#### CUTTINGS

Greenwood or semi-ripe nodal stem cuttings (see pp 101 and 95), 2/-3in (6-8cm) long, root easily Remove any soft tips and apply hormone rooting compound. Rooting takes +-6 weeks

Treat hardwood cuttings (see p 98) as above, but wound the bottom 7in (2cm) Keep frost-free Bottom heat of 54-68°F (12-20°C) speeds rooting. Larger cuttings, 8-12in (20-30cm) long. rooted in 5%-7in (14-19cm) pots, produce shrubs to plant out the next autumn. Cuttings taken in early winter may suffer from scab, preventing rooting

#### SEEDS

Extract seeds from berries in autumn and winter (see below). The seeds need three months' cold stratification (see pp 103-4) before they will germinate



GATHERING FIRETHORN SEEDS

Gather sprays of ripe fruits in autumn and winter Squash them to remove most of the flesh. then wash by rubbing them in warm water Sow fresh or store in moist sand in the refrigerator

### RHODODENDRON



klastatanaan A 1975

SOFTWOOD OR GREENWOOD CUTTINGS from late spring to st videncel till SEMI-RIPE CUTTINGS INTO to a major to a compile SEEDS IF WILL ASSAULT spring l LAVERING IT SHOTTING autumn l

GRAFTING in winter 1 This genus includes a wide range of deciduous and evergreen shrubby azaleas and rhododendrons that can be propagated in a variety of ways. Times vary for first flowering, from 2-5 years

#### CUTTINGS

or more

To root deciduous azaleas take softwood nodal stem-tip cuttings (see p.100) when the new growth is only an inchor two long, often when the shrubs are still flowering. Apply hormone rooting compound Cuttings are susceptible to scorch, so shade heavily on bright, hot days. Placing cuttings under mist works well Rooting takes 8-10 weeks. The greater the root growth before autumn the better, since overwintering smallrooted cuttings of deciduous azaleas is notoriously difficult. Placing rooted cuttings under fluorescent lights to extend the daylength in colder climates is beneficial

For evergreen azaleas and dwarf rhododendrons, nodal greenwood cuttings (see p.101) root more easily

Many of the evergreen, largeflowered hybrids root best from semiripe nodal cuttings (see p 95). Remove the tips, reduce larger leaves by up to a half, wound, and apply hormone rooting compound. Provide bottom heat of 54-68°F (12-20°C) for best results Rooting takes 10-15 weeks

#### SEEDS

Seeds from hand-pollinated plants often come true to type. Surface-sow the fine seeds (see p 104), gathered from dry pods, onto sieved acidic (ericaceous) soil mix. Ensure that the seeds do not

### RHUS SUMAC

ROOT CUTTINGS in winter & Division in late winter & SEEDS in winter and spring &

For deciduous and evergreen shrubs and climbers in this genus (syn Toxicodendron), root cuttings (see Celastras, p. 122) work very well, yielding saplings ready to plant out in a year. Sumacs sucker problically and so are easy to divide (see p. 101). Soak the seeds in hot water for 48 hours and chill for three months (p. 103) before sowing.

dry out by placing the pots or trays under mist, glass, or plastic wrap. Seeds need light to germinate Bottom heat at no more than 61°F (16°C) reduces germination time. Leave small seedlings in the container until the following year, or transplant them into cells. Grow on under protection and shade as required in summer, Transplant spring-sown seedlings the following year.

#### LAYERING

Air (see p.105) and simple (see p.106) layering both work well, if suitable shoots are selected (see below)

#### GRAFTING

Spaced side-veneer (see p 109) in winter onto pencil-thick seedling rootstocks, either pot-grown or bare-root. Suckering from the stock can be a problem, so the union should be as low as possible. A rooted cutting of R. 'Cunningham's White' suckers less often. Plunge bare-root stocks in moist peat to encourage a librous root system and a good root ball to develop quickly Callusing takes 6–8 weeks in a plastic tent at 59–68°F (15–20°C)



SELECTING SHOOTS FOR SIMPLE LAYERING A healthy, strong stem with green, flexible shoots (see left) will bend more easily and root more readily when layered than older, woodier stems (see right)

### RIBES FLOWERING CURRANT

SOFTWOOD OR SEMI-RIPE CUTTINGS from late spring to midsummer 11 HARDWOOD CUTTINGS from late autumn to midwinter 1 BUDDING in mid- to late summer 11 GAAFTING in late winter 11

Cuttings of these deciduous and evergreen shrubs are taken from softor semi-ripe wood for ornamentals and from hardwood for fruiting currants and gooseberries (Ribes uva-crispa var reclinatum). Standard gooseberries may be grafted. New plants mature or fruit in 2-4 years.

#### CUTTINGS

Softwood and semi-ripe stem and stemtip cuttings (see pp. 100-1 and 95) root reasonably well. Avoid using material affected with powdery mildew. For best results, take nodal stem-tip cuttings from 3-4in (8-10cm) of new growth, retaining the top two leaves. Apply hormone rooting compound, and protect young foliage from scorching

Take hardwood cuttings of currents and gooseberries (see right and p 98) Insert cuttings of gooseberries and redand whitecurrants (R. rubrum) to half their length. If desired, retain the top two leaves. Insert blackcurrant cuttings (R. nigrum) so that only two buds are above soil. Keep ornamental hardwood cuttings frost-free to ensure rooting

#### GRAFTING

Chip bud or whip-and-tongue graft (see pp 59-60) gooseberry scions onto a rootstock such as R. divarication or R. odoratum at 3-4ft (1-1 2m). If chipbudding, insert two facing buds

#### HARDWOOD CUTTINGS

PREPARING CUTTINGS Cut ripe shoots of gooseberries and currants to length (see left. Retain all the buds on cuttings of biachcurrant (to produce plenty of shoots at or below ground level, and of gooseberry (to assist rooting, Remove all but the top 3-4 buds of red- and whitecurrant cuttings to prevent suckeing

BLACKE URRANT 8-10m (20-25cm)

RLD: AND WHITECURRANT JZm (30cm)

GOOSEBLERY 12-15m (30-38cm)



handwood cuttings after one year. Rub out any shorts on the lower fin (10cm) of the stem of any buds from the base of each cutting before planting hand a constant of the base of each cutting before planting hand a constant of the base of each cutting before planting hand a constant of the base of each cutting before planting hand a constant of the base of each cutting before planting hand a constant of the base of each cutting before planting hand a constant of the base of each cutting before the planting hand a constant of the base of the

#### OTHER SHRUBS AND CLIMBING PLANTS

Principles Root softwood to semi-ripe nodal cuttings (see pp 100–1 and 95) in summer §. Sow seeds in autumn (see p. 103) § PROSTANTITERA Take semi-ripe nodal steming cuttings in late summer and autumn as for Phlomis (see p. 137) §§. Cuttings may rot Sow seeds in spring (see p. 104) §§ PROTEA Take semi-ripe stem-tip cuttings as for Oleana (see p. 135) §§. Sow seeds in spring (see p. 104) at 50–59°F (10–15°C) §§ Seedlings may damp off. Some species respond to smoke treatment (see p. 103) PTELEA Take greenwood nodal cuttings in early summer (see p. 103) §.

Presostyrax Root softwood nodal cuttings in early summer as for Carvopiens (see p. 121) § Sow seeds in autumn (see p. 103) §. RHAMNUS Root semi-ripe to hardwood nodal cuttings (see pp. 95 and 98) in autumn and winter in an open medium or rockwool

plugs with 50-59°F (15-20°C) bottom heat II. Sow seeds in autumn (see p 103) II. RHAPHIOLEPIS Root greenwood nodat cuttings as for Pyracantha (see p.138) 1. Sow seeds in autumn (see p 103) L RHODOTHAMNUS Root seim-ripe noda) cuttings (see p 95) in summer with 59-68°F (15-20°C) bottom heat 1. Sow seeds as for Rhododendron (see p 138) 4. RECOUNTED'S Root softwood to hardwood cuttings as for Forsythia (see p 128) L Sow seeds in autumn (see p. 103) 4. ROMNEYA For named custivers, take root cuttings as for Celastrias (see p. 122), but insert the root horizontally 👪 Soak seeds in alcohol for 15 minutes (see p 103): sow in autumn !! To avoid disturbing roots. transplant into cell packs. ROSMARINUS Take semi-ripe and hardwood cuttings as for Lavandula (see p. 132) L. Sow seeds in spring (see p.104) 1.

### RUBUS BRAMBLES

SOFTWOOD OR SEMI-RIPE CUTTINGS from spring to midsummer 2

HARDWOOD CUTTINGS in winter |
ROOT CUTTINGS in autumn and winter |
LEAF-BUD CUTTINGS in mid- to late summer |
Division from autumn to early spring |
LAYERING from late summer to early spring |

These deciduous and evergreen shrubs and climbers include raspberries (Rubus idaeus), blackbernes (R. fraticosus) wineberries (Rubus phoenicolasius), and many hybrid berries. Although they are long-lived plants, they can carry viruses so regular propagation maintains vigor Blackberries can be invasive in some areas, such as Australia. Brambles root easily from all types of cuttings, but division is best for rasphernes. For blackbernes and hybrid berries, leaf-bud cuttings provide large numbers of new plants, and tip-layering is best where only a few plants are required. Fruit and flowers are usually produced after 2-3 years, divided raspberries fruit after one year

#### CUTTINGS

Take softwood and semi-ripe cuttings (see pp 100 and 95) of ornamentals. They can be rooted directly in pots (see p 96) Cuttings inserted upside down root as well, if not better. Hardwood (see p 98, and root cuttings of deciduous species (see Celastriis, p 122) respond well.

Take leaf-bud cuttings (see p 97) where material is limited. Select a healthy section of cane about 12–18 in (30–45 cm) long, avoiding immature buds and choosing healthy buds with healthy leaves. Take a 1 in (2.5 cm) cutting, including a bud and about

in (1cm) above and below it insert in a mix of equal parts peat and sand, in trays or pots, in a humid, frost-free place (or under mist). Rooting takes 6-8 weeks. In spring, pot or plant out in a nursery bed 12in (30cm) apart in rows 3ft (90cm) apart. They will be ready to plant out in the following autumn or spring

#### DIVISION

This is best for raspbernes. Lift mature plants in the dormant season and divide (see p.101), keeping at least one cane and a good root system with each piece Plant in a new row. 15–18in (38–45cm) apart. Shorten the cane to 9in (23cm) just above a bud. For suckering species divide rooted suckers (see p.101)

#### LAYERING

Tip layering (see right) is the best way to propagate blackberries. It utilizes the plants habit of rooting from the tip when the canes touch the ground. For ornamental species, use serpentine layering (see p.107).

#### TIP LAYERING BRAMBLES



In late stommer choose a vigorous healthy cane preferably at the edge of the plant Bary the tip in a 4-bin (10-15cm) deep hale and firm If needed, pre the cane down



2 Keep the soil moist. The tip should root in a few weeks. Lift it at this stage and portion grow or a leave it until spring and transplact. When severing the tip from the parent plant rotain about 9m (23cm) of the old stem.

### SALIX WILLOW

SOFTWOOD OR SEMI-RIPE CUTTINGS from spring subtiner \$

HARDWOOD CUTTINGS from augustus to late writter \$ Seeds in spring \$1

The shrubby willows root very easily from cuttings. Take softwood or semiinpe cuttings (see pp 100 and 95), and root in containers in humid conditions. They can also be rooted outdoors under cover (see p.96). More vigorous species may put on 3ft (90cm) of growth (or more) before autumn. For dwarf willows, take 1in (2.5cm) softwood cuttings in late spring to early summer. Hardwood cuttings (see p 98) may be taken up to 8th-6ft (20cm-2m) in length, producing a mature plant a year or two earlier than standard cuttings. One way of obtaining young, straight shoots for large cuttings is to cut back a stock shrub almost to the ground each spring, a process known as stooling (see p 56)

If seeds are produced, they are viable for only a few days. Sow at once or store in damp peat in a refrigerator for no more than a month. Sow as for Clematis (see p. 123) and keep moist at all times. The seeds should germinate in 1–2 days.

A LIVING FENCI
This fence, just coming into bud in spring, has been woven from 6h (2m hardwood cuttings of Nalix vinimalis. The cuttings root readily to form a green fence. A few nurseries provide large hardwood cuttings, called sets, that can be inserted whole to form an almost instant windbrean on exposed hillsides.

### SAMBUCUS ELDFR

SOFTWOOD OR SEMI-RIPE CUTTINGS from spring to midsummer \(\frac{1}{4}\)
HARDWOOD CUTTINGS in winter \(\frac{1}{4}\)
SEEDS in spring \(\frac{1}{4}\)
GRAFTING in winter \(\frac{1}{4}\)

The deciduous shrubs in this genus root easily from softwood or semi-ripe nodal cuttings (see pp. 100 and 95) if suitable material is used. Avoid vigorous, pithy shoots, since these are likely to roi. Consider rooting directly in pots (see p. 96). If possible, take hardwood cuttings (see p. 98) with a heel, because large stems tend to be pithy and prone to rot. Root outdoors, or in containers in a frost-free place.

Gather the hard-coated seeds from the fleshy fruits (see p. 103) as soon as they ripen in summer. If stored dry in a refrigerator, they remain viable for several years, but are best sown fresh in autumn (see p. 104) where they will undergo a period of cold. Germination may occur in the first or second spring

Spliced side graft colored cut-leaved cultivars, such as Sambucus racemosa Plumosa Aurea', onto one-year-old S. mgra seedlings (see p 58) for a good-sized plant by the following autumn

### SOLANUM



Sокания э хрит хельпечаг

SOFTWOOD OR SEMI-RIPE
CUTTINGS from late spring to
late summer [1]
SEEDS in late winter to early
spring [1]

This genus (syn Lycianthes) includes semi-climbing wall shrubs, both evergreen

and deciduous, as well as the eggplant and potato (see p 307). Shrubby species are not usually difficult to root from cuttings. Winter cherries (Solanian pseudocapsicum) may be raised from seeds.

#### CUTTINGS

Solanum cuttings can suffer badly from borrytis and stem rots. It is best to take softwood and semi-ripe nodal stem cuttings (see pp. 100 and 95), 2—in (5–10cm) long, of the less vigorous new growth, select shoots with close-spaced nodes. Plants mature in 2–3 years

#### SFEDS

Extract seeds from ripe fruits (see p 103) and sow fresh (see p 104), covering with ain (1cm) of vermiculite. Provide 68°F (20°C) bottom heat to germinate within four weeks, and fruit in eight months

### SOPHORA

SEMI-RIPE CUTTINGS In late summer \$1 SEEDS in autumn or spring \$

The deciduous and evergreen shrubs in this genus belong to the pea family, so the hard seeds must be treated before sowing. Success with cuttings depends on obtaining suitable material. Plants flower in 3-4 years.

#### CUTTINGS

Semi-ripe cuttings (see p 95) are best selected from plants that are still producing good new growth annually prior to flowering. Once the plant has reached maturity, when only enough growth is produced to bear the new flower buds, rooting becomes much more difficult. Insert cuttings 2–3in (5–8cm) long, where possible with a heel (see p.96), in free-draining medium Apply hormone rooting compound and provide bottom heat of 59°F (15°C). Rooting takes 6–8 weeks. Harden off the seedlings, keep frost-free over winter, and pot in spring

#### SEEDS

Gather seed and soak for 48 hours (see p.103) to remove the sticky coating. Sow fresh (see p.104) in warm climates or store dry in a refrigerator. Before spring sowing, soak in hot water for 24 hours.

### SPIRAEA SPIREA

SOFTWOOD OR SEMI-RIPE CUTTINGS in spring to late summer \(\frac{1}{4}\)
HAROWOOD CUTTINGS in writter \(\frac{1}{4}\)
Division when dormant \(\frac{1}{4}\)

These deciduous shrubs all root readily from cuttings. Clump-forming species, such as 5. thunbergil, may be divided Plants flower in 2–3 years

#### CUTTINGS

Take softwood and semi-ripe stem cuttings (see pp. 100 and 95), 2-3in (5-8cm) long. Rooting takes 2-4 weeks. They may also be rooted directly in pots (see p.96) or in a sun tunnel (see p.39) With more vigorous species, such as S veitchit, hardwood cuttings (see p.98) root well in a frost-free place or in a deep container placed on a heated bed in a frost-free greenhouse

#### DIVISION

It is often a good idea to prune back the plant to within 12in (30cm) of the ground to make it easier to handle the clump before dividing it (see p 101)

### **STEPHANOTIS**



Stephanous floribunda

BEMI-PIPE CUTTINGS at any time 1
SEEDS in spring 1

These evergreen twining climbers and shrubs are easily increased from cuttings or seeds. New plants reach flowering size in 2-3 years

#### CUTTINGS

Root semi-ripe nodal cuttings (see p.95), with 2-3 nodes, at a temperature of 70-77°F (21-25°C), Stem-tip cuttings also do well (see p.101) Several cuttings can be made from one shoot. Rooting takes 4-6 weeks. Cuttings require shading and misting during very warm weather to prevent scorch. Alternatively, place the cuttings under plastic

#### SEEDS

Gather tipe seeds from the pods and sow fresh (see pp 103-4). Germination occurs at 68-77°F (20-25°C)

#### OTHER SHRUBS AND CLIMBING PLANTS

RUSCUS Take single-bud rhizome cuttings (see p 149) in early winter and grow on in a frost-free place 1. Divide clumps (see p.101) in early spring 1. Sow seeds in autumn (see p.103) 1

Retal Root greenwood to semi-ripe nodal cuttings (see pp 101 and 95) in summer and autumn without bottom heat 1. Sow seeds in spring (see p 104) 1.

SALVIA Take softwood to semi-ripe nodal cuttings (see pp 100–1 and 95) 1. Surface-sow seeds in spring as for Rhododendron (see p 138) 1.

SANTOLINA Take greenwood to hardwood nodal stem-tip cuttings (see pp.101 and 98)

11 Seeds in autumn or spring (see p.104) 11 SARCOCOCCA Root greenwood to hardwood nodal cuttings as for Busics (see p.120) 1. Divide suckers (see p.101) 1. Sow seeds in autumn (see p.103) 1.

autumn (see p.103) 4. SCHIZOPHRAGMA Root greenwood nodal cuttings in summer as for Pyracantha (see p. 138) 11 Results can be variable. Seeds. require three months of cold stratification. (see p. 103) before germinating \$\$ SENECIO Root greenwood to hardwood cuttings of hardy species at any time as for Lavatera (see p 133) L. Take greenwood and semi-ripe cuttings (see pp. 101 and 95) of tender species in summer and autumn 1 Sow seeds of hardier species in pots in spring (see p.103) in a frost free place 1. Sow tender species in spring (see p 104) at 59-68°F (20-25°C) L SKIMMIA. Take greenwood to hardwood.

nodal stem cuttings as for Escallonia (see p. 127) §. Sow seeds in autumn (see p. 103) §. SOLANDRA Root greenwood to semi-ripe cuttings (see pp. 101 and 95) in summer at 59–68°F (15–20°C) §. Sow seeds in spring (see p. 104) §.

SORBARIA Take softwood to hardwood custings as for Abiatlon (see p.118) ‡ Dig up rooted suckers (see p.101) ‡. Sow seeds in autumn (see p.103) ‡

SORBUS Saw seeds in autumn (see p 103) | SPARTIUM Seeds as for Chanthus (see p.124) | STACHYURUS Root greenwood nodal or heel cuttings (see pp 101 and 96) in summer | Avoid vigorous shoots. Cuttings may root but fail to grow away in spring despite initial flowering. Seeds in autumn (see p 103) | 1 | STAPHYLEA Root greenwood nodal cuttings (see p.101) in summer | Sow seeds collected in autumn immediately to avoid drying out and loss of viability; they require periods of warm, then cold, stratification (see p.103) | 1 | STEPHANANDRA Nodal or internodal stem cuttings as for Lavatera (see p.133) | Seeds as for Staphylea (see above) | 1 |

STREPTOSOLEN Softwood stem-tip cuttings in early summer as for Abution (see p 118) 1. Root semt-ripe cuttings in summer (see p.95) 11. Simple layer in late summer (see p.105) 1. Swainsona As for Chanthus (p.124)

SKIMMIA JAPONICA RI BELLA

## Symphoricarpos

SNOWBERRY

SOFTWOOD OR SEMI-RIPE CUTTINGS from late spring to early autumn | HARDWOOD CUTTINGS in winter | DIVISION from autumn to early spring | SEEDS in spring | |

These deciduous shrubs will root from 2–3in (5–8cm) long softwood or semiinpe stem cuttings (see pp 100 and 95) in 2–4 weeks, maturing in 2–3 years. They may be rooted directly in pots (see p.96) or a sun tunnel (see p.39). Take hardwood cuttings as shown (see right).

Prune back, lift, and divide overgrown clumps (see p.101). Spring-sown seeds need warm, then cold, stratification (see p.103) to germinate the following spring



I Hold 10-15 tipe shoots of current season's growth there of Symphoricarpos albus) together and cut into sections, each the length of the pruners. The the attends into bioudles. Trun so that they are all the same length



2 Fift a pot with a free-draining medium (here equal parts potting mix and grit). Insert the bundles so that the lower half to two thirds are buried Label. In early spring, plant out the motted cuttings singly to grow on

### SYRINGA LILAC



S I go regard

Only cuttings from nonripened wood of

the deciduous shrubs in this genus root, and seeds may be unreliable. Layering was the standard method until mist units arrived and is still easiest for the gardener. Lilacs are easy to graft, but suckers may be a problem. New plants take three years or more to flower.

#### CUTTINGS

Take stem cuttings (see p. 100) from 2in (5cm) softwood shoots. With hormone tooting compound, free-draining medium, and bottom heat of 59°F (15°C), rooting takes 6-8 weeks. Root cuttings grow as easily as suckers, take as for Celastrus (see p. 122), but insert singly in pots

#### SEEDS

Io ensure even germination, sow fresh seeds (see p. 104) to chill over winter (see p. 103). In early spring, apply 68°F (20°C) bottom heat. If spring-sown seeds (see p. 104) germinate poorly, chill over winter to germinate next spring

#### LAYERING

Simple layer (see p. 106) with a 2in (5cm) tongue, lift in the following spring.

#### GRAFT NG

Grow Syringa vulgaris rootstocks from root cuttings and cut back to 2in (5cm) to avoid suckering. Apical wedge graft (see p 108) with a 2-4in (5-10cm) scion. In winter, whip graft (see p 109) onto bare-root two-year-old seedlings.

### TAMARIX TAMARISK

SOFTWOOD CUTTINGS from late spring to midsummer \$\frac{1}{4}\$
HARDWOOD CUTTINGS in winter \$\frac{1}{4}\$
SEEDS in spring \$\frac{1}{4}\$

The deciduous and evergreen shrubs in this genus have weak roots, which can be a problem with cuttings. Plants mature in three years.

#### CUTTINGS

Softwood cuttings (see p.100), 2-4in (5-10cm) long, root easily in free-draining medium, but foliage rois if kept humid for too long. Root singly in cells of pots to avoid weak roots dropping off when potting rooted cuttings

Try rooting hardwood cuttings (see p 98) in deep trays in a frost-free place, then grow on for a year to allow a much bigger root system to develop. Then pot plants directly into 5/4-7in (14-19cm) pots, or plant out in the garden

#### SEEDS

Store seeds extracted from dry capsules in a refrigerator (see p. 102) to preserve their viability. Spring-sown seeds (see pp. 103–4) should germinate readily

### **TIBOUCHINA**

GREENWOOD CUTTINGS IN SUMMER \$\$
HARDWOOD CUTTINGS IN WINTER \$
SEEDS in spring \$\$

The evergreen shrubs in this genus root easily from hardwood cuttings outdoors (see p.98) in free-draining soils in warm areas, otherwise, they need 59–68°F (15–20°C) bottom heat. Sideshoots of greenwood root well insert nodal stemtip cuttings (see p.101) in free-draining medium with bottom heat of 59–68°F (15–20°C). Rooting takes 6–10 weeks Germinate seeds (see p.104) at 68–77°F (20–25°C)

### VACCINIUM

SOFTWOOD OR SEMI-RIPE CUTTINGS from late spring to late summer \$11 HARDWOOD CUTTINGS II WAR I \$1 PROPERTY AND THE SERVINGS II WAR I \$1 PROPERTY AND THE SERVING \$1 PROPERTY AND THE WARTER \$1 PROPERTY AND THE WAR

This genus includes evergreen and deciduous shrubs, many with edible fruit. They include bilberries (Vaccinium myrtilius, V. caespitosum) and whortleberries (V artiostaphylos, V parvifolium. V myrtillus). The most popular of the genus, blueberries, are not easy but may be grown in several ways, cranberries are prostrate and suited to layering.

#### CUTTINGS

Highbush blueberries (V. corymbosum) root best from 4-3 in (1-2cm) softwood shoots (see p. 100) or 4-6 in (10-15cm) midsummer cuttings (see p. 95). Retain the top 3-4 leaves, root in free-draining medium at 64-68°F (18-20°C). Pot in spring and grow on for a year.

Evergreens root best from semi-ripe material (see p.95). In areas with long, hot summers, hardwood cuttings (see p.98) of deciduous species can be taken from fully opened wood. Root in a frost-free place or in deep pots.

Cut rhizomes of lowbush blueberries (V angustifolium var laevtfolium) into 4in (10cm) pieces and root in perlite with 68°F (20°C) bottom heat, as for Beigenia (p. 190)

#### OTHER METHODS

Divide mature clumps of the cowberry (V vitis-idaea) and replant (see p. 101) Surface-sow seeds on acidic (ericaceous) soil mix; cover with finely ground sphagnum moss, and keep moist until germination. Simple or self layer (see pp. 106–7) cranberries (V macrocarpon) and species that are difficult to root.

### **VIBURNUM**

GREENWOOD CUTTINGS from rate spring to early summer 11

SEMI-RIPE CUTTINGS from midsummer to autumn [1]
HARDWOOD CUTTINGS in wither [1]
SEEOS in autumn of in spring [1]
LAVERING in spring [1]
GRAFTING in late summer [1]

The evergreen and deciduous shrubs in this genus fall into groups for propagation. Plants flower at various ages, from 2-3 years onward

#### CUTTINGS

Greenwood cuttings (see p 101) are best for Viburnian carlesti cultivars and deciduous winter- and summer-flowering viburniums. For the former, take early cuttings; overwintering can be difficult Insert nodal stem-tip cuttings, with a pair of leaves and three nodes, in free-draining medium. Halve large leaves Hormone rooting compound improves rooting to 4-6 weeks. Root vigorous material directly in pots (see p 96). Pinch out terminal flower buds on new plants.

Evergreens root well from semi-npe nodal or internodal cuttings (see p 95) Hormone rooting compound and gentle

bottom heat speeds rooting to 6–8 weeks. Deciduous winter-flowering species also root from hardwood cuttings (see p.98) if kept frost-free and rooted in deep pots at 54–68°F (12–20°C) Internodal hardwood cuttings of evergreens, no more than 2/m (6cm) long, root well in 6–8 weeks in rockwool Bottom heat of 54–68°F (12–20°C) and humidity speed rooting Keep the rockwool moist at all times

#### SEEDS

Sow seeds of species fresh (see below), they germinate more quickly with a period of warm, then cold, stratification (see p.103); seeds sown in spring (see p.104) germinate in the following year

#### LAYERING

Many, especially the V. carlesis group, may be simple layered (see p. 106)

#### GRAFTING

Whip graft (see p 109) scions of V carlesti and V x burkwoodii onto potgrown V lantana or V opulus seedling rootstocks. Suckering can be a problem

## VISCUM MISTLETOE

SEEDS in early spring \$1

These parasitic, evergreen shrubs may be found growing in apple orchards. Choose a mature, strong tree that wilt not be weakened by the parasite, of apple, ash, cedar, hawthorn, larch, linden, oak, or poplar. Squash some fresh bernes and insert the very sticky pulp directly into a wound on the branch on which the mistletoe is to grow (see below). Seed germination and growth for the first couple of years are slow.

#### PLANTING MISTLETOE SEEDS



I Select a branch (here of an apple tree) 4m (10cm) or more in girth and 3ft (1.5m) from the ground. Make two short cross cuts in the back lift the flaps, push in some seeds (inset)



2 Cover the wound with a small piece of burlap or moss and secure with twine or raffia. This will protect the seeds from birds and from diving out until they germinate

#### SOWING VIBLANUM SEEDS



In late autumn, squash freshly collected a professor of Viburnum betaliforum?

Prepare a pot with soil-based potting mix

Scatter the pulp and seeds evenly on the surface

2 Cover with an and table cover with an and table coverage the series to germonate this takes 6-18 months. Fransplant single into pots and grow

IN for two years

#### OTHER SHRUBS AND CLIMBING PLANTS

SYMPLOCAS Root greenwood noda, cuttings as for Pyracantha see p [38] I. Sow seeds as for Staphylea (see p. 141) 11. SYNGONILM Take softwood stem up (see p 101) or leaf-bad cuttings (see p. 97) in summer & TECOMANTHE Sow seeds at 64-70°F (18-21°C) in spring (see p. 104) L. Root semi-ripe cuttings (see p 95) with bottom heat in summer & Serpentine layer (see p. 107) in spring 1 TELOPEA Root semi-ripe noda: stem-up cuttings (see pp 95 and 101) in late summer and autumn in free-draining medium II

beeds have low viability; sow fresh 2-3 seeds in a 3 /m (9cm) pot at 77°F (25°C) (see p 104) 11. Thin to one seedling, plant out after first flower in 2-3 years. Ternstroemia. Root greenwood to semi-ripe todal cuttings (see pp 101 and 95) in summer and autumn in free-draining medium. I. Seeds in autumn (see p.103) 1. Teccrium. Softwood to semi-ripe nodal cuttings (see pp.100-1 and 95) from summer to autumn. I. Sow seeds in spring (see p.104) at 68°F (20°C) 1.

THUNBERGIA Greenwood nodal cuttings (see p 101) throughout

p 104) at 68-7. F (20-2) () §. THYMUS See Culmary Herbs p 291

TRACHELOSPERMUM Root green wood to semi-ripe nodal of internodal cuttings (see pp.101 and 95) in summer and autumn with 15–20°C (59–68°F) bottom heat 4. Simple or serpentine layer (see pp.106–7) spring 4. LGNI Take semi-ripe cuttings as for Callistemon (see p.121) 4. ULEX Greenwood and hardwood cuttings as for Genista (see p.129) 4. Soak seeds in hot water and sow in autumn or spring (see

pp 103-4) with no bottom heat 4. VINCA Take greenwood and semi-ripe internodal cuttings (see pp 101 and 95) at any time. For bushier plants, insert at least one and a half nodes below medium surface, new shoots then develop above and below surface. Avoid material with diseased black stem lesions. Divide clumps (see p 101) in early spring 1 VITEX Root greenwood to semiripe cuttings (see pp 101 and 95) in summer with no bottom. heat 1. Sow seeds in spring or autuma (see pp 103-4) in a frost free place |

### VITIS GRAPE

SOFTWOOD OR SEMI-RIPE CUTTINGS from late spring to midsummer 1 HARDWOOD CUTTINGS in late autumn or winter \$ SEED IN Spring LAYERING in spring 2 GRAFTING in mid- to late winter 111

Genus of deciduous twining climbers Many wine and dessert grapes are cultivars of Vitis vinifera. There are also hybrids between V. vinifera and V. labrusca. Most species root well from cultings. V. coignetiae is difficult to root but responds well to layering Grafting vines can be used to increase vigor or resistance to pests

Take softwood or semi-ripe nodal cuttings (see pp. 100 and 95), 3in (8cm) long with three nodes, from closenoded, thinner growth, which roots more quickly Reduce foliage on largeleaved species by up to a half. Apply hormone rooting compound. Rooting takes about four weeks. Harden new growth before winter

For all hardwood cuttings (see above right and p 98), check that the wood is still green in the center, since dieback can be a problem. In late autumn, before winter cold sets in, prepare vine eyes by making a cut above a bud and another

STANDARD HARDWOOD CUTTINGS OF VITIS

ROOTED CUTTINGS Hardwood cuttings may be taken in two lengths with 3-4 buds or with one bud (vine eyes). The ratter root less readily but yield a greater monibor featings



2in (5cm) below the bud, Insert in deep trays vertically with the bud on the medium surface, and root in a frost-free place or with bottom heat of 64°F (18°C) in early winter, take 2-3ft (60-90cm) cuttings from prunings, and tie them in bundles. Heel in, in a sheltered place, to two-thirds of their depth. In mid- to late winter, prepare standard-length cuttings (see above) from the prunings and root in pots (see below)

Sow seeds after a short period of chilling (see pp 103-4). Serpentine layer

(see p.107) V. coignetiae

Whip-and-tongue graft (see p.59) one or two scions onto suitable stocks in areas affected by the vine phylloxera. ta serious pest affecting roots and leaves). Use the same graft for weakgrowing cultivars

### Wisteria



SOFTWOOD CUTTINGS from a c spring to midsummer 1 HARDWOOD CUTTINGS I winter 1 ROOT CUTTINGS in lave 13.78 SEE08 in early spring | LAYERING in spring 1 GRAFTING IT late winter 1

With the last s formosa

These vigorous. deciduous, twining climbers are best increased by layering and cuttings

### CUTTINGS

Take softwood cuttings (see p. 100), 24-3in (6-8cm) long from less vigorous sideshoots with closely spaced nodes Rooting takes 6-8 weeks. Harden the cuttings and encourage good root growth before winter. New shoots are unlikely to appear until the spring Hardwood cultings (see p.98) root best in a sheltered place or in deep pots in a frost-free greenhouse. Given bottom heat of 54-68°F (12-20°C), root cuttings (see p 158) %-1 /m (2-4cm) long produce new shoots in 4-5 weeks

### SEEDS

Seed-raised plants are of varied quality and take years to flower and so are only useful as rootstocks. Soak dry seeds for 24 hours before sowing (see pp. 103-4)

### LAYERING

The long shoots produced annually are ideal for serpentine layering (see p 107)

### GRAFTING

Apical-wedge graft (see p. 108) onto two-year-old Wisteria stnensis seedlings, or onto lengths of root (see below) Plunge the graft into moist peat, keep humid, and provide 59-68°F (15-20°C) bottom heat. The union should callus in 3-6 weeks. Harden, then pot when the buds begin to swell

# WEIGELA

SOFTWOOD OR SEMI-RIPE CUTTINGS from late spring to midsummer 1 HAROWOOD CUTTINGS in winter \$ SEEDS in spring |

7 Root the cuttings (here of Vitas vinifera) in

with bottom heat of 70°F (21°C). A propagating

A soil-based potting mix in a frost-free place

blanket is ideal for large numbers

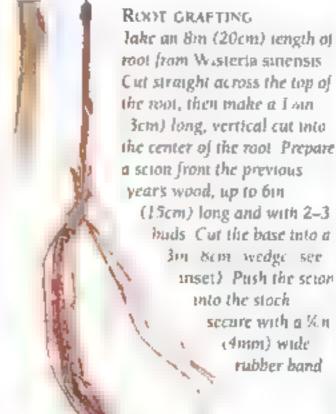
These deciduous shrubs root very easily from cuttings. Take softwood and semitipe nodal stem cuttings (see pp. 100 and 95), 24-3in (6-8cm) long. Rooting takes about four weeks. Consider rooting directly in pots (see p.96) or in

a sun tunnel (see p.39) In colder areas, semi-ripe cuttings mot well in cold frames. Hardwood cuttings (see p 98) may be rooted in a sheltered place or in deep containers

Extract seeds from the dry capsules and sow in spring as for Phlomis (see p. 137) or in sheltered seedbed. They should germinate in a few weeks and produce flowering plants in 2-3 years



When the cuttings break into bud in spring (above left), pot them singly (above center) Grow them on until the following spring (above right) before planting them out



the root, then make a Lain. 3cm) long, vertical cut into the center of the root Prepare a scion front the previous year's wood, up to 6in (15cm) long and with 2-3 buds. Cut the base into a 3m 8cm wedge see inset) Push the scion into the stock secure with a Min (4mm) wide rubber band

### YUCCA

SOFTWOOD CUTTINGS from late spring to summer \$
BUD CUTTINGS in early spring \$
DIVISION in rate winter and early spring \$
SECOS in spring \$

The evergreen shrubs in this genus make striking specimens. With the hardier, stemless species, it is possible to propagate from the swollen buds or "toes" produced on the roots, or from suckers. With the tender, stemmed species, you can use stem cuttings. New plants will be a good size in 2–3 years

### CUTTINGS

Young tender species often produce small shoots from the main stem that can be used as softwood cuttings (see p.100). Rooting takes 8–12 weeks

For the tender Yucca elephantipes, you can take stem cuttings from mature shoots (see below). Cuttings may be placed horizontally in trays to induce young shoots, if none are available, for use as softwood cuttings. If the cuttings are to be grown on, they are best inserted vertically

For root cuttings of hardier, stemless species, uncover the roots of a mature plant, or lift the entire plant, in early spring and cut off the swollen buds (see below left). If the buds are not yet breaking, dust with fungicide. Insert these individually into 3½in (9cm) pois,

and cover well with soil mix. By autumn, you will have a well-established plant ready for planting out or growing on for another year in a 7in (19cm) pot

### DIVISION

For many of the smaller hardier, stemless species, division of suckers (see below right) works well. Shade new plants to prevent them from being scorched by the sun until established.

### SEEDS

Soaking yucca seeds for 24 hours before sowing (see pp 103-4) can speed germination, but is not necessary Provide bottom heat of 59°F (15°C)

### TAKING YUCCA BUD CUTTINGS



I knower the roots of a mature plant (here Yucca Haccida)
Remove swolien buds (toes) from the parent rhizome cutting straight across the base of the toe



2 Pot cach toe singly in a free draining medium, at twice its depth. Water, label. With historical heat of 59–68°F (15–20°C) the for will mot in 2–3 weeks (see mise).

### DIVISION OF YUCCA SUCKERS



In spring, carefully uncover the base of a sucker (here of Yucca thansen one that it off at the base where it joins the parent rhizomi thust the wounds with funguide



2 (\* the surker singly in a free-draining medium, such as equal parts soilless poiting mix and fine grit Label Keep at 70°l [21°C) until rooted (12 weeks)

### TAKING STEM CUTTINGS FROM A YUCCA

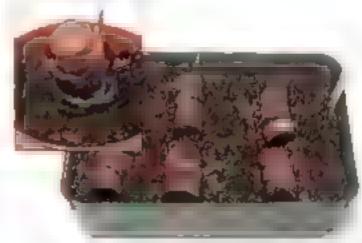


Remove a 1-3ft (30-90cm, section from a mature stem (here of Yucca elephantipes) among between the leaf nodes



the stem Cut the stem tuto cuttings about 4m (10cm) fong (see inset) trum alternately below a node and above a node with clean, sharp primers

3 Strap all



3 Press the cuttings harizontally into a tray of most soilless rooting medium so they are half buried, or insert single cuttings vertically onto 35in (9cm) pots. Keep hiomid at 70–75°E (21–24°C) until new shoots appear

### OTHER SHRUBS AND CLIMBING PLANTS

Wastring A Root greenwood and semi-ripe cuttings (see pp. 101 and 95) in summer and autumn in a very open medium with bottom heat of 59–68°F (15–20°C); do not allow the foliage to get too wet 12 Wigandia Take greenwood

cuttings (see p.101) in early
summer \$\frac{1}{2}\$. Sow seeds in spring
or under cover in winter (see
p.104) at 55–64°F (13–18°C) \$\frac{1}{2}\$.

XANTHOLERAS Take root cuttings
as for Celastrus (see p.122) \$\frac{1}{2}\$. Sow
seeds in autumn (see p.103) \$\frac{1}{2}\$

XANTHORHIZA Take greenwood

nodal cuttings (see p. 101) in early summer J. Divide clumps (see p. 101) in spring and autumn J. Sow seeds in autumn (see p. 103) J.

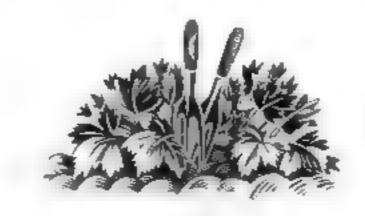
ZANTHONYLOM: Take root cuttings as for Celastrus (see p. 122) J.

Divide rooted suckers (see

p 101) in early spring § Sow seeds in autumn (see p. 103) §.

ZENOBIA Root semi-ripe nodal cuttings (see p. 95) in late summer in free-draining medium at 59–68°F (15–20°C) § Sow seeds as for Rhododendron (see p. 138) §.





# PERENNIALS

Propagating this hugely varied group of plants enables the gardener to keep existing plants healthy and vigorous, replace short-lived perennials as they fail, and build up stocks for an attractive border display

The term "perennial" strictly describes any plant that makes growth for three years or more, but in horticulture it is applied to non-woody perennial plants. Many make totally new herbaceous growth before flowering and seeding each year and die back in winter, especially in colder regions, but some are evergreen

Perennials form a group of enormous value to the gardener, encompassing not only traditional border plants but alpines, water garden plants, ferns, and ornamental grasses including bamboos. Orchids and bromeliads are also perennials, grown mostly in warm-climate gardens or as house- or greenhouse plants in colder areas. These popular groups of plants are generally propagated using some specialized techniques.

The majority of perennials make new growth from the base, or crown; their roots or rhizomes spread (unless confined in containers) and the plants naturally form clumps, making division an obvious choice for propagation. Using division, the gardener can not only reinvigorate mature plants but acquire several small portions of the same plant, complete with their own roots and shoots, which can immediately be planted elsewhere in the garden as new plants.

Commercial growers take very many small

LATE-SUMMER POLLINATORS

Both the flower form and cotor range of Aster attract bees and butterflies (ate in the season These plants benefit from regular, even annual division, flowering more freely and being less prone to infection by powdery milden.

divisions from stock plants and grow them on in controlled environments; gardeners can often adopt these methods

To give impact to plantings, perennials are often required in quantity – seeds or cuttings provide the means. Many perennials are easy to raise from seeds (spores can similarly be used for ferns), but new plants take longer to flower, and home-gathered seeds do not always come true to type. Cuttings raised in suitable conditions offer the best way of obtaining offspring that are clones of the parent, including cultivars with special characteristics such as particularly colored or large or double flowers; plants bred not to flower, such as the lawn chamomile 'Treneague'; foliage plants with finely cut, differently colored, or variegated leaves, single-sex plants; and sterile hybrids.

DRIED THISTLE SEEDS

Like many sea holkes, Eryngaum
giganteum does not readily tolerate
root disturbance and is better raised
from seeds. It is more poetically
known as Miss Willmott's Ghost.
because it would mysteriously appear
in every garden this Victorian plantswome

in every garden this Victorian plantswoman visited: she scattered seeds of this, her favorite flower, wherever she went

# DIVISION

The easiest method of vegetative propagation for perennials is by division. It is the method most commonly used by gardeners for rejuvenating an old plant while providing extra plants and commercially for propagating many garden perennials in large numbers

Most perennials should be divided every three to four years to keep them healthy and vigorous. Most of the late summer-flowering, fibrous-rooted plants, such as hardy chrysanthemum cultivars and Michaelmas daisies (Aster) flower best when divided annually or biennially. Perennials such as bearded irises produce new rhizomes each year The clumps should be split and the divided rhizomes replanted every three years or so

However, a few genera, such as peonies, Podophyllum, and to some extent hostas, prefer to be left alone and should be divided only for propagation

Plants are divided in autumn or early spring, when they are not in active growth Spring- and early summer

bloomers such as hly-of-the-valley (Convallaria), Epimedium, and Uvularia are left until after flowering. If necessary. most perennials can be divided at any time, except during hot, dry periods and freezing winter weather

Early-summer division of some perenntals works well, for example Pulmonaria and early-blooming bearded irises. At this time of year, new roots grow and any damage heals quickly reducing the risk of rot. Potting the divisions may help them establish, keep them shaded. Some early-flowering plants, such as hellebores and peonies form the following year's flower buds in mid- to late summer, divide these in late summer or early autumn to ensure flowers the next spring. All plants that are divided in summer should be watered thoroughly until they establish

The secret of successful division at any time is always to have more root than shoot to cut away excess foliage and to keep the divisions moist and sheltered until established

### PREPARING THE SOIL

Division provides a good opportunity to improve the soil. Bulky organic matter. be it compost, leaf mold, or well-roited manure, can be worked in where plants have been lifted. If replanting in the same site add a little slow-release fertilizer such as bonemeal to give a good start to the new plants. Replanting divisions in a different site, however helps maintain vigor and counteract any buildup of pests or of diseases in the soil

### SEPARATING PERENNIALS

Not all plants need to be lifted to separate them. A number of perennials naturally produce new plantlets around the parent, and these can simply be dug up and removed without lifting the parent plant. Some, such as strawberries. produce rooted runners (see p 150) Perennials such as bugle (Ajuga) form mats of individual rosettes, lift a matand pull it apart gently into individual rosettes or lift just a few from the edge

### PERENNIALS WITH MATURE CROWNS



1 Divide plants with a spreading rootstock A such as this Helianthus, early in spring tust as the new growth is breaking. Lift the plant with a fork inserting it well away from the crown to avoid damaging the roots



2 Shake the roots free of locse soil Divide the plant into smaller pieces by chopping through the woody center with a spude. Try to avoid damaging the fresh, young growth around the perimeter of the plant



LARGE PLANTS Some large perenntals do not have woody crowns but become monand more congested at the center Divide such plants (here a daylily) with two forks held back to back. Lever the forks backward and forward to loosen the roots



3 Pull the divisions into smaller pieces with your hands. Make sure that each piece has a good root system and several new shoots Discard the old, woody center and any other pieces without plenty of strong, new growth



4 Replant the divided sections immediately to T the same depth as before spacing them well apart to allow for new growth. Firm in lightly and water thoroughly, taking care not to wash away any soil and expose the bests



SEPARATING CLUMPS

SMALL PLANTS To divide a small perennial there a gentian), lift the comp and gently pull it apart, using two hand forks held back to back. If the plant is very congested, cut it into pieces with a sharp kinfe

### **DIVIDING RHIZOMATOUS PERENNIALS**



1 For perennials that have a thick the decome (here an iris), life the whole clump with a garden fork. Shake the roots free of soil and break the clump into manageable pieces with your hands.



2 With a clean, sharp knife, cut the new, young rhizames from the climp. Make sure that each piece has a gend root system and a fan of leaves. Discard the old. exhausted rhizomes in the clump.



3 Dust the cut surjaces of the thizomes with a fungicide to prevent not. Trim the roots by up to one-third. To prevent wind nock on inses, trim the leaves to about 6in (15cm) in a mitered shape.



4 them into the divisions. Settle them into the soil so that the top of the rhizome is just barrey covered with soil. Firm in well and water is galaxly until established.

of the mat. While this is not division in the strict sense, the results are similar the spread of the parent is restricted, and new plants obtained

### DIVIDING PERENNIALS

When lifting plants for division, shake or wash them free of soil, using a hose or a bucket of water. Cleaning the rootstock reveals any natural lines of division, so the plant can be split easily with minimum damage to roots, buds or shoots.

Pulling the plants apart rather than cutting them does less damage. Small plants such as Heuchera and primroses and those with a loose clump of underground stems, such as Dicentra formosa, Epimedium pinnatum, and Geranium sanguineum, can be pulled apart into pieces. With some plants that have a large mass of roots, such as I ly-of-the-valley, a hand fork is very useful for teasing out small pieces.

For larger fibrous-rooted perennials the traditional method of splitting clumps using back-to-back garden forks (see facing page, below) is hard to beat Perennials with a tight woody crown (Astilbe, hellebores, Geranium pratense cultivars, and Trollius), rhizomatous perennials, and those with fleshy roots, for example delphiniums, herbaceous peonies, and Rheum, need to be cut apart. A spade or an old, strong knife is ideal.

As much as possible, care should be taken to avoid damaging the roots during division. Treatment of root damage differs, depending on whether the perennial is a dicotyledon or a monocotyledon (see page 17). Most perennials are dicotyledons, if any damaged or oversized roots are trimmed nearly after division, root growth should continue unabated. Monocotyledonous perennials — in which single, large leaves, rather than leafy stems, arise from the crown, such as with hostas, rhizomatous trises, and Lysichiton — are unable to

regenerate damaged roots. Cut such roots back to the crown to encourage formation of new roots

The exposed roots of divided plants should never be allowed to dry out. If there is to be a delay between lifting and replanting, the divisions should be heeled in, either in a spare corner or a box of moist soil mix or peat. Plastic storage crates are ideal for this purpose

### CARE OF DIVISIONS

As a general rule, try to divide plants into good-sized portions, each with vigorous, new growth. If a plant is divided into many small pieces, the divisions will take longer to mature to flowering size than a few, larger pieces Established clumps may have woods centers, these parts lack vigor and are best put on the compost pile. Also, discard any damaged portions

Once the parent plant has been divided, trim off any dead or damaged material (see facing page). Use a clean, sharp knife to avoid introducing disease into cuts. Badly damaged roots or shoots can also be treated with a fungicide to protect against rot entering the wounds. Vigorous, healthy, and relatively undamaged divisions with three to five shoots and good roots.

can be replanted immediately (see facing page) or lined out for growing on in a nursery bed. Plant divisions in a nursery bed at about one-half to two-thirds of the usual spacing appropriate for a plant in the open garden.

Pot smaller pieces individually, each in a pot just larger than its roots, and place them in a sheltered place to grow on until they are established. Be aware though that many plants (particularly those with fleshy roots) that are fully hardy in the ground will die if their roots are exposed to severe cold while in pots. In colder climates, therefore, they will need to be plunged or taken under cover (see pp 42–43) over winter. When they are of a reasonable size, replant the divisions into prepared soil.

very small divisions of hardy perennials should be encouraged to put on as much growth as possible before the end of the growing season. Pot them in a fertile, free-draining soil mix, such as one part fine grit to two parts soil-based potting mix, which will provide nutnents for growth, and place under cover where the temperature is higher than outdoors. This will extend their growing season. Provide shade in summer to protect the young plants from scorch, and keep well watered



Benefits of division
Left to their own devices
perennials such as the
Henchera shown here can
deteriorate in vigor and
appearance as old, woods
stems develop at the base of the
plant. Flowering performance
can also be impaired. To
maintain the plant at its best
divide it every four years or so

Old, woody stems produce few new leaves

### SINGLE BUD DIVISIONS

In commercial propagation, some general are reduced to single buds to maximize yields of new plants identical to the parent. It is most often practiced on monocots such as Agapanthus, daylihes (Hemerocailis), and hostas but also on many other perennial cultivars. Best results are obtained from division in spring just as the plants start into growth

Single bud division (see right) can be undertaken by the gardener. Make sure that a good portion of root is taken with each division, and avoid inflicting any more damage than is necessary. Grow them on in a sheltered nursery bed, or pot them into deep 3½ in (9cm) or, for larger plants, 5in (13cm) pots, making sure that each bud is covered to the same depth as it was before. Greater protection from extreme temperatures (see pp.38–45) is needed for these divisions in the early stages.

If more plants are wanted quickly single fleshy buds of plants such as hostas may be divided in half vertically through the bud crown, but this does encourage rot, absolutely scrupulous hygiene is essential. Pot halved buds in deep 5in (13cm) pots and give bottom heat (see p 41) to increase growth and help the buds establish quickly

D VIDING CONTAINER-GROWN PLANTS Division of container-grown plants is usually very successful. Plants with rooting stems, or runners, such as the mother of thousands saxifrage (see right), need not be removed from their pots at all but can be encouraged to develop new plantlets by pegging the runners into small pots of soil mix Fleshy-rooted plants such as spider plants (see below, right) actually divide and reestablish better if containergrown, because it avoids the damage to the roots caused by lifting from the border. They can be divided at any time, but ideally after flowering or when dormant

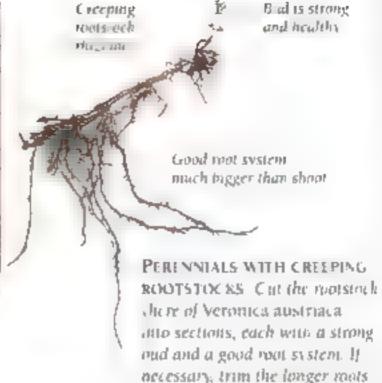
To divide a container-grown perennial, knock it out of the pot, then wash the soil mix from the roots of preferred, to reveal the natural lines of division. Pull the plant into good-sized pieces (usually three or four). With potbound plants, it may be necessary to cut through the crown with a large knife and tease the roots apart from the top. Be careful not to cut into and damage the roots.

Trim any damaged roots on the divisions, according to whether the plant is a dicotyledon or monocotyledon (see p 149), and pot singly. Use a soil-based potting mix, which provides stability to the root ball and consistent levels of nutrients and is easily rewetted if the soil mix dries out

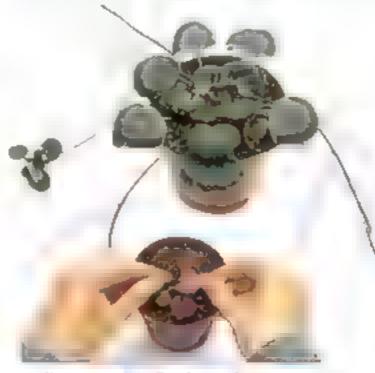
### SINGLE BUD DIVISIONS



FLESHY-ROOTED PLANTS Pull apart the crown making sure each piece (here of a hosta) has a single, plump bud and a good root system. Line out the divisions in a nursery bed at the same depth as before and 6in (15cm) apart, or poi



### PROPAGATION OF ROOTING RUNNERS



Prepare a in (8cm) pot of moist rooting on him Peg a runner (here of 5axilraga stelle indera down so that the base of the phantiet is in contact with the sou mix stuface



2 Once moted, usually after a few weeks sever the runner close to the new plant Grow on the plantlet until the roots fill the pot, then pot into soil mix

### DIVIDING A CONTAINER-GROWN PLANT



1 Water the plant well (note that Chlorophytum comosum) and let it drain. Stide the plant from the pot and shake off the soil mix Loosen the root bull from below, gently pry apart

2 Irim any diseased or dumaged thich mots from each division, leaving fibrous feeding roots intact. Pot singly into pots about %in (2cm) wider than the noot ball (see inset), using a similar soil mix.



# SOWING SEEDS

Seeds provide a simple and economical way of raising large numbers of perennials, although it has limitations. Many cultivars do not come true from seeds, and even commonly grown species display some natural, albeit acceptable, variation in the seedlings. However, there is always a chance of producing a seedling that is superior to its parents.

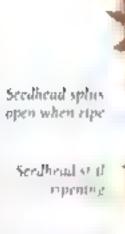
Some cultivars do, however, come reasonably true to type, including some delphiniums, lupines, and Oriental poppies (Papaver orientale). Seedlings with colored, marbled, or variegated leaves, such as Henchera cultivars, vary in color, so poor forms need to be regued out at an early stage.

Seeds also offer the only way of raising monocarpic species, such as Meconopsis that die after the first flowering Perennials that are very slow to increase vegetatively, such as Hepatica and Pulsatitla, may be raised in large numbers commercially from seeds

GATHERING PERENNIAL SEEDS

Saving seeds from one's own plants is easily done by the average gardener. Many perennials produce seeds readily, often in papery capsules or pods. Gather from plants with the best characteristics of the form to ensure good-quality seedlings. Seedheads can ripen quickly so watch them closely and gather the seeds before they are dispersed. Choose a dry day to ensure that the seeds are not damp and at risk of rot.

In some cases, for example with trises and peonies, seedheads are obvious and easily seen, whereas other seedheads, as with Hepatica and primrose (Primula valgaris), are hidden among the foliage Remove each seedhead and crush it between two pieces of wood or with your fingers to release the seeds over



GATHERING SEEDS
Perennials such as
hollyhocks can be
raised from seeds
Gather the seeds
when just ripe
before they falt





SURTING SPEDS Seeds can be cleaned using specialized stacking sieves. Lightly crush dry seedheads through a sieve with a mesh just larger than the seeds. The seeds fall through this top sieve and are caught in the sieve with a finer mesh below. Fine chaff sifts through and collects in the dish below

a clean sheet of paper. Euphorbia and some other perennials have seedpods that "explode" to eject the seeds or disperse them very rapidly; remove these seedheads on their stems as they turn brown and place in a paper bag Always label bags of seeds when you gather them to avoid confusion later

### SORTING AND CLEANING SEEDS

A simple way to clean gathered seeds is to place them in a shallow container and blow lightly over them to clean off dust and chaff, leaving the seeds behind. Use kitchen, homemade, or specialized (see above) sieves with metal gauze to clean seeds thoroughly for storing. An assortment of mesh sizes will be needed for differently sized seeds. Use one sieve to hold coarse chaff, a finer sieve to catch the seeds, and a tray to receive dust. Take care not to confuse seed sieves with kitchen sieves, some seeds are toxic.

Gather bernes as soon as they are ripe of plants such as hly-of-the-valley (Convallaria) and Polygonatum, then macerate them. Place the bernes in a sieve under running water and rub off the pulp. Alternatively, add the mashed bernes to a bowl of water and stir well. The pulp and dead seeds usually float, viable seeds should sink. Pour off the pulp and dry the seeds on paper towels.

WHEN TO SOW PERENNIAL SEEDS

Some seeds are best sown immediately after gathering. Seeds of perennials that flower in early to midsummer germinate more quickly and uniformly if sown fresh, for example lupines, primroses, or poppies (Papaver). Some perennials, such as Meconopsis or Primula, have very short lived seeds. Euphorbia, gentians, and several others are best stored in a

cool place until autumn and sown then Seeds of later-flowering perennials, if sown in autumn, will not germinate until early spring. In most cases, such as for most chrysanthemums and asters, these seeds may be stored over winter and sown in spring

### STORING SEEDS

Seeds must be stored in a cool, dry place, humidity and warmth cause seeds to deteriorate and die. A good place to store seeds is in the refrigerator at 41°F (5°C) Place dry seeds in labeled paper packets in an airtight, plastic container

A little desiceant, such as silica gel, placed in the container will remove excess moisture. Place a packet in with the seeds or, better still, sprinkle gel in the bottom of the container and sit the seed packets on a piece of metal gauze above the gel. Another option is powdered milk from a newly opened box, although this can be used only once. Both of these products absorb moisture from the air and reduce humidity. Avoid opening the container unnecessarily.

### SEED VIABILITY

The usual reason for germination failure is that dead seeds are sown. Seeds fail for a number of reasons: the seeds may not be fertilized or (continued on p. 152).

TESTING SEEDS FOR VIABILITY Add medium-sized or large weds to a jar of water. Viable seeds sink to the bottom, while dead hollow seeds float. After drying them off sow the viable seeds immediately.





### SEEDS FROM DRIED BERRIES



Some perential berries (here of Actaea spicata may be dried for storage. Before sowing, crushthe dried perries with a wooden presser or weight then sieve to sort the chaft from the seeds

(continued from p. 151) may fail to fully develop, hybrid seeds may have defective genes, or seeds may be damaged by fungal or insect attack. After sowing, seeds may be killed by rot, rodenis, or severe cold.

### TREATING DORMANT SEEDS

Some perennial seeds have built-in dormancy to delay germination in the wild until conditions occur that are beneficial for seedling development (see pp 19-20). There are several ways to break this dormancy before sowing to obtain a

### SCARIFICATION BY SOAKING



Some seeds (here of lupines) have hard coars that are broken down naturally by moisture. Prepara them for sowing by souling them for 24 hours in a saucer of cold water. Sow immediately

good rate of germination. Hard protective seed coats in perennials are most common in the pea family (Fabaceae). The seed coats must be scapfied so that moisture can enter. Gardeners are often advised to file seed coats, but anyone who has tried this with dozens of lupme seeds knows it is painful and time-consuming A better way of scarifying larger seeds is to rub a batch with fine-grade sandpaper (see Shrubs and Climbing Plants, p. 102)

With seeds gathered in cool, moist summers, it is often sufficient to soak the seeds (see above), if the seeds are

large or from plants grown in hot, dry conditions, pour boiling water over them and allow to stand in the cooled water for 24 hours. Sow soaked seeds immediately, otherwise, they will die

Many perennials, particularly those from mountainous or harsh climates have seeds that do not germinate until after a cold period. The seeds must be chilled (stratified) before sowing in spring by placing them in a refrigerator or sown in autumn in regions with cold winters (see opposite

A few perennials, such as peonies, are doubly dormant and require a period of cold then warmth, followed by a second spell of cold. If the seeds are not sown fresh, they take two years to germinate naturally. This can be overcome by subjecting the seeds to artificial temperature changes

To override chemical inhibitors (see p. 19) in the seeds of some perennials. the seeds are sown as soon as they are fully formed before the inhibitor is activated, sown after storing when it has broken down, or soaked in water for 48 hours to leach out the chemical, as with rhizomatous irises

PREPARING CONTAINERS FOR SOWING Perennial seeds are often sown in pots or half pots of 37/m (9cm) to 5m (13cm) Seeds that germ rule quickly

### RAISING PERENNIALS FROM SELDS



1 f.lt a container here a 5m 1 (13cm) pot, with moist seed sod moe Firm it gently to no more than on (1cm) below the ron-



Sow the seeds here of Leucanthemum x superbum) thinly and evenly from a folded piece of paper or from the packet



2 Cover with a shallow layer of sieved soft mix. Label and stand the pot in water until the surface darkens, allow it to drain

# SOWING FINE SEEDS



Very Jine, dustlike seeds (here of Campanula) conbe mixed with fine sand to make it easter to sow evenly Place the seeds and a little sand in a plastic bag and shake well



4 Cover the pot with a sheet of glass or plastic wrap to prevent moisture loss. Place in a sheitered place at a suitable temperature



When the seedlings have two I seed leaves, transplant singly L'se degradable pots (see inset) for plants that dislike root disturbance



As soon as the seedlings have O a good root system, plant them out into their final positions or pot them on, as appropriate



Fold a piece of clean paper a m half to make a funnci and place some of the sand and seeds muxture on the crease. Gently tap the paper to sift the seeds over the soil mix

### VERMICULITE TOP-DRESSING



Seeds in containers may be covered with a san Simm) layer of face-grasse vermiciatite instead of sold max. This allows air and light to reach the seeds, reducing the risk of damping off (see p.46)

and easily, such as of delphiniums or lupines, or those of plants that dislike root disturbance, are best sown singly in cells or plug trays (see p.31), use one with cells large enough for seedlings to reach a good size before potting

Soil-based seed soil mixes (see pp.33-4) are best for most perennials unless the seedlings will be transplanted soon after germination. A good home made seed soil mix can be made of two parts sterilized soil, two parts peat or leaf mold, and one part sharp sand. For autumn sowings, equal parts coarse sand and peat, bark fiber, or soil works equally well.

To prepare a container for sowing, fill it generously with soil mix, tap to settle it, scrape off the excess, and firm with a presser or base of an empty pot

### SOWING SEEDS IN CONTAINERS

Take care not to sow (see facing page) too thickly, which could lead to spindly seedlings and damping off (see p.46). Cover with screened soil mix or for seeds that need light to germinate or germinate quickly, top-dress with vermiculite (see above). Large seeds may be space-sown pushed into the soil mix with a presser and covered with %in (5mm) of soil mix. Seeds that must not dry out fare better when sown on moss (see pp.165 and 208,

After sowing, water containers using a fine rose or by standing the container for 30 minutes in a tray of water this avoids disturbing the soil mix surface and seeds. Cover the container or place in a closed case to prevent moisture toss, and shade it from sun if necessars. Remove the cover after germination

For most seed germination, an ideal temperature is 60°F (15.5°C). Keep seeds of very hardy plants at 50°F (10°C); they will germinate at lower temperatures, but it takes longer. Tender species need a minimum of 68°F (20°C). If containers are sown in autumn for stratification by winter cold, cover the

### STRATIFYING SEEDS



In cooler climates, plunge pots of seeds up to their tims in an open bed of sand, bark fibet, or soil over winter so that cold will encourage the seeds to break their dormancy and germinate

or coarse sand to discourage weeds and protect seeds from rain. Pack the containers into an open cold frame or sink in a plunge bed (see above). The bed keeps the soil mix moist and protects clay pots and plant roots from cold damage Cover the containers with fine mesh to protect the seeds from birds and rodents

Seeds of perennials can be fickle Seeds that normally germinate quickly may not do so, and supposedly dormani seeds may germinate rapidly. It is wise to keep pots or trays of seeds for a year after the expected germination date

### HANDLING THE SEEDLINGS

Seedings need bright light and regular watering. If using rockwool plugs or another mert medium, feed the seedlings once they have two true leaves with a liquid fertilizer according to the manufacturer's instructions.

Transplant seedlings 30 or 40 to a tray or individually into plugs, cells, or pots (see facing page) as soon as they are large enough to handle. If the seedlings germinated under cover at a frost-free

temperature, it is better to pot them when they are slightly larger. Always handle seedlings by the leaves. Use soil-based potting mixes (see pp 33-4) or a mix of three parts sterilized soil, two parts peat or leaf mold, and one part sharp sand

Grow on the seedlings in a sheltered place until well established. Plant out fast growers into their final positions in the same year, but delay planting out slow developers until the next spring. These are better potted or grown on in a nursery bed for a year.

### SOWING SEEDS OUTDOORS

Easy perennials may be raised in a seedbed, the seeds are best spring-sown in drills as for annuals or biennials (see pp 218–19). If needed, thin the seedlings as they grow; when they are about 3 in (8cm) tall, lift and plant them out

Seeds that germinate slowly may rot if the soil mix decomposes, so these are better sown directly into a seedbed in a cold frame. Sow them in rows, label, and top-dress with fine gravel. Keep the bed moist and weed-free, be aware that organisms working through the bed may displace the seeds.

Seedlings may need potting or transplanting after only a few weeks; if left too long, they become crowded and drawn as they compete for light and air

### HYBRIDIZING PERENNIALS

Many perennials, such as daylilles, inses, chrysanthemums, or hostas can be hybridized (see p.21), sometimes with exciting results. It helps to focus on one group, research its characteristics, and have a specific aim, such as to produce larger-flowered, hardier Agapanthus

Alternatively, simply plant suitable parents together, let the bees do the work, gather the seeds, and select from the resulting seedlings. Be ruthless and keep only the best examples.

### TRANSPLANTING SELF-SOWN SEEDLINGS



Many perennials
such as these Oriental
poppies (Papaver
crientale) italiardus
seed themselves about
the garden

I se a trawel to lift each seeding with enough soil to avoid disturbing its root ball Replant the seedings immediately into prepared soil in a suitable site, firm gently label, and water Keep watered and shaded if necessary until they are established

# TAKING CUTTINGS

A wide range of perennials can be propagated from cuttings, using a variety of plant parts, stems, leaves, and roots. In most cases, some form of controlled environment – a heated closed case, greenhouse, or cold frame, for example – is necessary to encourage the cutting to regenerate missing parts, such as roots. If these conditions can be provided, cuttings are ideal for obtaining a number of new perennials that will be ready to plant out, and may even flower, in their second year

Mature plants recover well from having a modest amount of cutting material removed, or stock plants can be cultivated especially for the purpose of providing cuttings. Good hygiene – clean, sharp tools, sterile growing media, and the prompt removal of dead or damaged material or of any cutting in a batch that shows disease – helps ensure success. With some perennials, you can take cuttings at almost any time of the year they are not in flower, whereas with others material is suitable only during a few weeks or even days. If taken after

flowering, many cuttings will root and grow well. Cuttings from perennials that die down over winter should be taken early in the growing season so that the cuttings have plenty of time to form good root systems capable of coming through the next dormant period

### ROOTING MEDIA

Materials into which cuttings are inserted must give them support and be sterile, water-retentive, and well aerated mixtures of peat and fine grit, perhite, vermiculite, or sand are among the most popular (see p.33). Several inert media can also be used rockwool (see p.35) and vermiculite are popular for stem cuttings, for some tricky alpines, ground pumice is used (see p.167). Some easy-to-root plants will develop roots from stems that are simply suspended in water (see p.156).

### PROTECTING CUTTINGS

Cuttings taken from the topgrowth of perennials are usually soft or semi-ripe, and it is essential that their tissues

remain turgid (well supplied with water). In dry air or in wind, water will be lost from stem and leaf surfaces and the cutting will rapidly wilt, so a sheltered, humid growing environment is essential. In tropical and subtropical climates, stem cuttings may root well in open ground, but in other zones they must have protection in a greenhouse or plastic-film tunnel or, on a small scale in a closed case or a cold frame or covered on a shaded windowsill.

Stem cuttings are in general more likely to root if provided with bottom heat, making the exposed growth cooler than the buried part. Care will be needed in the weaning of protected cuttings from warmth and high humidity to open-air conditions, and a period of hardening is essential be careful, too not to overwater cuttings until they are well established.

### TAKING CUTTINGS FROM STEMS

Stem, stem-tip, and basal stem cuttings can all be used to propagate perennials, they may be soft-, green-, or semi-ripe wood, depending on the stage of growth It does no harm to most garden plants to take shoots formed in the first flush of growth as cuttings, leaving the second for flowering. If you do this, delay any

spring feeding until cuttings have been taken, because rooting will be improved if the stems are not too sappy. Take material where possible from the younger, more vigorous shoots at the edge of a clump

Profile of the second s

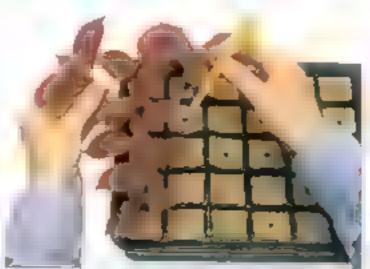




Select close-noded, healthy shoots from the current season's growth, here from a colcus (Solenostemon). Remove each one by cutting tast below a node, and 3-5m (8-13cm) below the shoot tip, with a clean, sharp km/s



2 Place the cuttings in a plastic bag or bucket of water until they can be prepared. Trum off the lower leaves with a clean, sharp knife or purch them off with your fingers. Take care not to leave any snags, which might rot



3 To insert cuttings into the rooting medium here rockwool) make small holes. For cells, as here, make one hole per cell insert each cutting so its leaves sit just above the surface. Firm in gently, water, and label



4 Place the cuttings in a closed case or tent them under plastic (to keep humid) in bright light at a minimum temperature of 64–70 f (18–21°C). After about two weeks, the cuttings should have developed roots (see inset)



D singly into 4th (10cm)

pots of soilless potting mix. Do not tease out the roots from rockwool modules. Label, water, and grow on in a warm, bright place.

### PROMOTING ROOTING OF CUTTINGS



HORMONE ROOTING COMPOUND To encourage root formation, prepared cuttings here of balvia todantha) can be disped into a hormone rooting powder or (as here) gel

Stock plants kept to supply cutting material should be young and vigorous

Do not use high-nitrogen fertilizers on

stock plants, or cuttings from them will prove difficult to root

The softer the growth, the faster it will root but the more vulnerable the cutting will be to pests and diseases and adverse conditions. Periodic checks for pests such as aphids on cuttings taken in late summer and early autumn such as of violas and penstemons, is vital pests weaken soft cuttings very quickly Preventative sprays or drenches with a fungicide are also advisable.

With nearly all plants, the lower cut is made just below a leaf joint, where natural growth hormones (auxins) are more active in the initiation of roots. A hormone rooting powder or gel (see above) helps, most plants root well but more slowly without it

STEM-TIP CUTTINGS

Soft- and greenwood cuttings are taken from new growth in spring to early summer, or from greenhouse plants soon after they start into growth in mid- or even late summer, spring and early summer bloomers such as Aubricta and violas that have been cut back after flowering will also produce suitable soft shoots. As might be expected from the name the stems should be soft almost succulent, if bent they will snap, or squash if pressed. Given the right conditions, softwood cuttings root quickly, usually in less than two weeks

Semi-ripe cuttings are taken from shoots that are in active growth but where basal parts are beginning to ripen, usually from midsummer to mid-autumn. Such cuttings will bend without snapping and will not crush readily. These cuttings need protection from cold to root well but they are more resistant to adverse conditions. Rooting

HUMIDITY For cuttings inscried in a pot, cover with a plastic bag held clear of the cuttings on split stakes Secure the bag with a rubber hand to keep it arreight This maintains the humidity around the cuttings and prevents am moisture loss

takes longer, from four to eight weeks. Once the cuttings have rooted, they should be potted into a suitable soil mix (see p.32). A cold frame, greenhouse, or plastic-film tunnel can all be used for growing them on, or, in warm climates, a sand bed in a sheltered spot. In all cases, shade them from strong sun

### STEM CUTTINGS

On long main-stemmed perennials such as Lobelia cardinalis hybrids and Veronica, one can get several cuttings

STEM-TIP CUTTINGS IN A ROLL

Let a black plastic strip about 6in (15cm) wide and 2ft (60cm) long. Cover with a Lin 25cm) layer of damp sphagnum moss. Place the cuttings so their leaves sit just clear of the moss.

3 When the toll is complete, secure with rubber bands, then laber Place the roll out of direct sun at a minimum of 70 F 21 C). Cover to keep the cuttings build and water from the top as necessary to keep the moss motst.

from one stem by cutting it into sections 2-3in (5-8cm) long. The top of each cutting is trimmed just above a leaf and the base just below a leaf. Take off the bottom leaf from each cutting and perhaps one or two more on leafy stems, so that there is a sufficient length of bare stem to insert into the rooting medium. Treat stem cuttings thereafter exactly as for stem-tip cuttings.

METHODS FOR EASILY ROOTED PLANTS
A space-saving method when taking large numbers of stem cuttings from easily rooted plants, such as Penstemon Aster, Dianthus, Euphorbia, Phlox, and Lysunachia. is the moss roll (see below) developed by professionals but very easy to use for home propagation

Sphagnum moss may be replaced with coarse peat, finely shredded bark or rockwool. The plastic may be folded over at the base before being rolled up to retain loose peat or bark, but the roll will need careful watering to avoid waterlogging and rot. Stand the roll in a closed case or tent it in a plastic bag Water the roll regularly and thoroughly from above and allow it to drain

Stem-tip cuttings of very easy-totoot perennials, for example Penstemon, Gazania, and Tradescantia, may be rooted in water (continued on p.156)



2 Space the cuttings on the "inside" end of the strip about 3in (8cm) apart, and gradually reduce the spacing to 2in (5cm) at the south d'end. Roll up the strip, starting at the inside end



4 When the cuttings show signs of growth after 4-6 weeks, unroll the strip. Tease the cuttings out of the moss, Pot them singly in 3in (8cm) pots of soilless potting mix

(Continued from p 155) Place the cuttings in a jar of water (see right) on a greenhouse bench or windowsill. Shield from strong sun to reduce the growth of algae. Aftercare is as for stem-tip cuttings

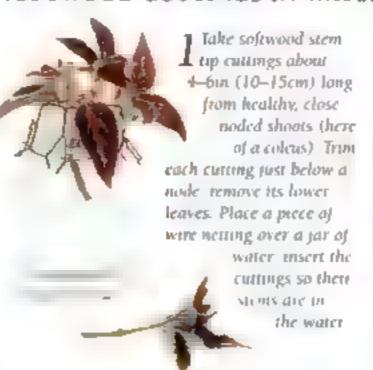
### BASAL STEM CUTTINGS

These consist of entire young shoots severed from the crown of the parent plant so that each retains a piece of parent tissue at the base. They are strong shoots in active growth and quick to form roots, unlike more mature shoots dedicated to producing flowers

If taken very early in the season from summer-flowering plants such as asters, phlox, and salvias, basal stem cuttings should make reasonably sized flowering plants by summer or autumn of the same year. Commercially, this is popular because it cuts out a year's production it also allows cuttings to put on the maximum amount of growth before the next dormant period, benefiting plants such as salvias that might otherwise not come through a harsh winter.

Basal stem cuttings of many perenmals may be taken from the first flash of new growth in spring. Even carber cuttings can be obtained by light forcing of plants that have been lifted and potted in the previous autumn

### SOFTWOOD CUTTINGS IN WATER



(as with the delphinium below) and started into growth in a greenhouse, plastic-film tunnel, or cold frame. Some plants, including delphiniums, Diascia, and violas, can also be induced to form material suitable for basal stem cuttings later in the season cut back flowered stems to the crown and top-dress with organic fertilizer to encourage the plant to produce sturdy, new shoots quickly

Some perennials, notably lupines and delphiniums, have hollow stems that tend to rot in soil mix. It may be difficult



2 keep filling up the water so that the lew stems of the cuttings are always submerged After 2-4 weeks, the cuttings should have well developed roots. Pot singly in Jin (8cm) pots of sandy potting may Water and tabel

to obtain good material from them for softwood cuttings, but taking basal stem cuttings seals the stems against rot. For hollow-stemmed cuttings, a light, open medium such as vermiculate or perlite (see below) is effective in preventing rot, regularly spray or drench the cuttings with fungicide

Basal stem cuttings may also be taken from rootstocks, such as of chrysanthemums, that have been overwintered under cover, the rootstocks are usually then discarded

### DELPHINIUM BASAL STEM CUTTINGS IN PERLITE



I in spring, select new shoots that are about 3-4m (8-10cm) long. Cut off at the base each with a piece of the parent's woody crown trim off all except the top two or three leaves



2 With a clean, sharp knife, remove any damaged tissue or stubs from the bottom third of the stem of each cutting



3 Fill a bin (15cm) pan with moist perfect a within tin (25cm) of the rim. Stand the pot in a saucer of water. Gently push in about eight cuttings so that they are half-buried.



A Label the pot and stand in its saucer of water in a warm place out of direct sunlight. Keep the perlite constantly moist. The cuttings should root in 4-8 weeks and are ready for potting when the new toots are about Ain (1cm) long, Ease them out gently and give a light tap to knock any loose perlite off the roots.



5 Pot the rooted cuttings singly into 3in (8cm) pots of soilless potting mix at the same depth as before Firm gently label, and water Grow on the cuttings for 6–8 weeks until they are established before planting them on

### BASAL STEM CUTTINGS



In spring, when the new shoots emerging at the base of the plant there a Chrysanthemum) are just 3—4 in (8–10cm) tall, out them cleanly through at the junction with the woody crown tissue.



2 trim the bases, cutting straight across below a node if visible, or so the cuttings are 2 n norm long treat the base of each cutting with hormone mortang is water or get



3 Insert the cuttings into pots of rooting medium. Water well and label Put the cuttings in a closed case or tent them in a clear plastic bag. Bottom heat speeds rooting



4 When well rooted, usually after about four weeks, separate the cuttings. Aim to keep disturbance to the roots to a manifement. Put the cuttings singly in potting pax (see inset).

because the new plants will have more vigor than the parent (see above)

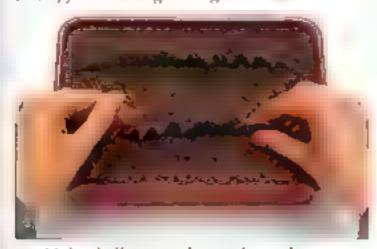
Since these cuttings are usually taken early in the season, bottom heat (see p 41) improves rooting. A suitable propagating medium may be mixed from equal parts sand and peat. Hormone rooting compound often helps, as does dusting with a fungicide.

A cold frame, greenhouse, plasticfilm tunnel or in warm climates, a sand bed in a sheltered spot, shaded from hot sun, can be used for growing on the cuttings

### PART-LEAF CUTTINGS



I Select a healthy, full grown leaf and cut it mid sections so that the veins in the leaf are wounded. Here a Streptocarpus leaf is cut in half and the midrib discarded. Prepare a seed tray of free-draining rooting medium.



2 Make shallow trenches in the medium then assert the leaf cuttings in them, eat side down. Firm gently around the base of the cuttings. Put the tray in a closed case or seal in a plastic bag to prevent moisture loss.

### LEAF CUTTINGS

Some plants can regenerate both roots and shoots from partial or whole leaves. Generally, variegated leaves cannot be used for leaf cuttings, new plants will be plain green. There are two types of leaf cutting. With the first, new plants form on the surface of a sectioned leaf as in many Streptocarpus (see left) and Sunsevierta

The second utilizes a whole leaf and its stalk and usually a dormant bud at the base of the stalk where it joined the stem. On some such as African violets the bud is not crucial because a new one will form. In many, including Ramonda and petiolares-type alpine primroses the bud must be preserved: without it, the cutting will root but a new rosette will not form. The buds are not visible removing a leaf by holding it and drawing it downward (never tug) usually keeps the bud intact.

De-pot or dig up a plant and remove most of the soil mix or soil to get at outer leaves from rosettes, they may look messy but usually work well

Leaf cuttings need a free-draining rooting medium, such as equal parts coarse sand or perlite and peat, and they may be inserted singly or several around the edge of a pot. They are usually taken early in the growing season, but cuttings of many tropicals and house plants such as Peperomia may be taken at most times of the year if given a period of warmth to initiate regeneration. Tropical cuttings must be kept in high humidity at around 68°F (20°C). New plantlets should start to form in a few weeks

Nontropical species, such as those raised from whole-leaf cuttings, are taken in mid- to late spring. They are usually covered to maintain humidity but do not need extra heat at this time of year. By midsummer, new young plants should develop and can be potted in a suitable soil mix (see p.32).

### WHOLE-LEAF CUTTINGS



Lut healthy, mature leaves (here of African violet, Saintpaulia) from the parent plant, close to the base of the leaf stalk. Insert in pots of equal parts peat and course said so that the base of each leaf just touches the sione.



Water the cuttings, allow to drain, then tabel them. Cover to prevent moisture loss here, clear plastic bottles are cut down to make improvised cloches. Shade the cuttings from direct sunlight.

3 should form around cach leaf base Remove the covers and allow the new plants to grow on until they are large enough to be teased out and potted individually in soil less potting mix

### ROOT CUTTINGS

While it is easier for a root cutting to develop shoots than a stem cutting to form roots, not all root cuttings develop new roots as readily as a stem cutting Root cuttings are best taken from a plant when it is most dormant, in mid-to late autumn or early winter Root cuttings cannot be used to increase variegated plants, although new plants will grow, their leaves will be plain green

Plants with thick roots such as Papaver orientale, Symphytum, and Verbascum can be propagated by this method it is often advised that root cuttings should be of pencil thickness, but in fact many perennials do not have many roots this thick, and thinner root cuttings are often just as, if not more, successful. The thinner they are the longer they should be. With very thin-rooted plants such as phlox, choose the thickest roots and lay the cuttings horizontally on, rather than inserted upright in, the rooting medium

Root cuttings from many suitable popular perennials should grow well in a cold frame. Extra protection may well be needed in cold weather to prevent the soil mix from freezing. Root cuttings from marginally hardy and tender plants should be kept at a minimum temperature of 45–50°F (7–10°C).

When new growth can be seen on cuttings in spring, check to see if they are well rooted before poiting them root cuttings produce shoots some time before any new root growth occurs, and cuttings must not be poited until a new root system has formed

MINIM ZING ROOT DISTURBANCE

Some plants, such as Pulsatilla, grow well from root cuttings, but the parent plant will suffer a check in growth from the root disturbance. The plants can be container-grown and encouraged to send down roots for cuttings into a sand or gravel bed (see Eryngium, p. 196). If the plant is in the ground, cut around it some 4in (10cm) from the crown, lift it carefully, and replant elsewhere. Severed roots should be visible around the walls of the hole. Do not fill in the hole, but place a sheet of glass or clear, rigid plastic over it for protection, and mark it with stakes. Leave until new shoots are visible around the hole walls, then lift and pot the plantlets to grow on

### LAYER NG PERENNIALS

A few perennials with a prostrate habit, such as scrambling phlox, or sprawling stems, such as pinks (see Dianthus, p 193), may be layered as for woody plants (see p 106). The best time is late winter, before growth begins, or autumn, after new growth is complete. Separate new plants in the next growing season

### ROOT CUTTINGS



I lift the plant (here an Acanthus) in late autumn when it is dormant and wash the roots free of soil 1 hoose strong roots, of medium thickness for the plant and sever them from the parent suiting as close to the crown as possible. Remove no more than one-third of the available root material from the parent plant.



2 a rach root into sections that are 2-4ar long making the thiomer cuttings to torgest. To make sure that you insert the arrangs the right way up, cut it chase of each cutting at an angle and cut the top of cach cutting straight deross (see insert



3 Prepare pots of tooting medium, water them, and allow them to drain Treat the cuttings with a fungicide to prevent rot. Make holes as deep as the cuttings in the medium and insert them vertically, angled end down the top of each cutting should be level with the surface



4 lop-dress the cuttings with a win (lentlayer of coarse sand or grit, label, and put them in a cold frame, closed case or, in warm climates, a sheltered place. Slow-rooting species may benefit from bottom heat. Water the medium only to prevent drying out until the cittings show signs of rooting.



5 When new topgrowth appears, usually by the following spring, gently tease out the cuttings and check for troot growth. When ready, pot the cuttings individually in 3m (8cm) pots filled with soil mix Water them well then label (see inset). Grow on the rooted cuttings until they are of sufficient size to plant out.

### ALTERNATIVE METHOD FOR THIN ROOT CUTTINGS



Cut roots into sections 3-5in (8-13cm) long depending on the plant. Cut straight across at both ends of each cutting. Lay the cuttings horizontally, about 1in (2.5cm) apart, on moist rooting medium in trays. Cover the cuttings with Ain (5mm) of medium, firm, then allow to root (see steps 4-5,

# **FERNS**

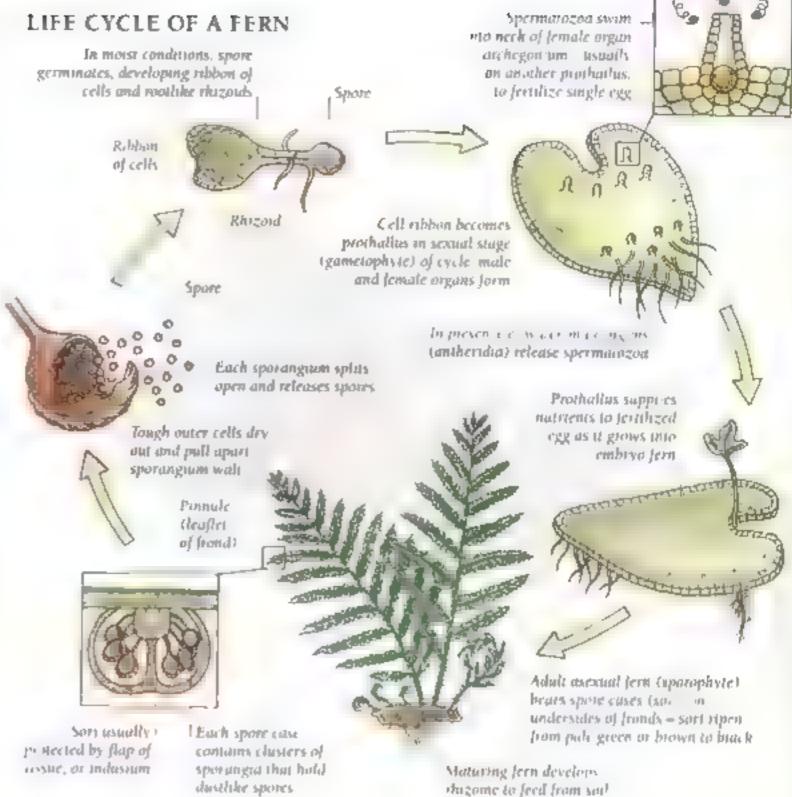
Ferns are primitive plants that, lacking flowers, reproduce by spores rather than by seeds. Increase from spores is the usual method of propagation where many plants are wanted. However, it is tricky and not always possible spores may not form when cultural conditions are less than ideal, some ferns are sterile; and many crested or plumose cultivars do not come true from spores. Many ferns also reproduce by vegetative means, such as by rhizomes, bulbils, or plantlets. These can all be exploited by gardeners to increase stocks.

### **SPORES**

The fern life cycle (right) has two phases, a sporophyte (spore-bearing) asexual stage, familiar as the fronded plants we grow, and a sexual gametophyte stage called the prothallus, produced when spores are dispersed from the fern and germinate. It is at this stage that fertilization takes place, enabled by water, since the male sperm must swim to the female egg, this is why ferns grow in moist places. An embryo develops, then a recognizable fern, when mature, the fern will produce spores, continuing the cycle

### GATHERING SPORES

Spores of most temperate fern species ripen in mid- to late summer; those of many tropical ferns ripen less seasonally through the year (continued on p. 160)



### A-Z OF FERNS

ADIANTONI MAIDENHAIR FERN Sow fresh spores at 59°F (15°C) for harder species, 70°F (21°C) for tender ones 1. Divide rhizomes (p. 162) anto intege pieces (closely spaced nodes) in early spring 1. Root plantiets at frond tips of tropical species such as A. candatum 11. Antaopienis Chant On King Fern Detach suricles (p. 163) 11

ASPITATION (syn. Ceterach, Phyllins) Spleen-WORT Sow spores as for Adiantum & Root bushils or plantiets (p 161) on frond midnb on A bultiferum, at base of frond on harts tongue fern (A. scolopendrium), especially sterde cultivars such as 'C rispum 44. Divide (p. 162) hardier species in spring L Root planticis at frond tips of A. rhizophyllium 1. ATHYRIUM LADY FERN. Sow spores as for Adiantum. Root titty bulbils (p. 161) from base of frond stalks 111. Divide side-crowns (p. 162) without afting parent (especially A filex femina cultivars that do not come true) 1. BLECHNOM HARD OR WATER FERM Spores in ate summer at 59°F (15°C) | Divide (p. 162) in spring, only B. perua-marina and B spicant establish easily in colder areas. Take plantlets from stolons (p. 162) 11

CIBOTICM Sow green spores as soon as ripe at 70°F (21°C) 1

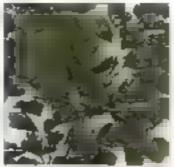
CYATHEA (SYR. Alsophila) TREE FERN SOW fresh spores at 59–64°F (15–18°C) 1. Take ollsets from trunks or roots (p.163) 11 CYRICOREM SOW spores at 61°F (16°C) 1. CYSTOPTERIS BLADDER FERN SOW spores at 61°F (16°C) 1. Root bulbils (p.161), under frond midribs of C. bulbifera 111. Divide rhizomes (p.162) in spring 11 Divide creeping rhizomes or root aerial thizomes (p.162) 1. Dicksonia. Sow spores as for Cibotium 1. Take offsets from trunks (p.163) 1.

Dicksonth Sow spores as for Cibotium 1.
Take offsets from trunks (p.163) 1.
Dietazith Sow fresh spores at 70°F (21°C) 1.
Root bulbils (p.161) of D. bulbiferum 1.
Detach plantlets from creeping roots (p.162) of D. bipinnatifidum and D. esculentum 1.
Distorpients Bucklett feek. Sow fresh spores at 59°F (15°C) 1. Divide in spring or autumn (p.162), especially cultivars and forms 1.
I will a feek. Sow spores as for C. normal 1. Divide if 162 before growth begins. Layer climbing stems (p.163) 111
Marattia. As for Angiopteris.

MATTERCOA Sow fresh spores at 59°F (15°C) 4. Divide or detach side-crowns early spring & NUPHROLEPIS SWORD FERN. Sow spores as for Cibotium & Take plantifets from runners, esp of cultivars and root aerial stolons (p 162) 1. ONOCLEA SENSITIVE FERN. As for Matteuccia & OSMENDA Sow green spores as soon as ripe at 59°F (15°C) 1. Divide in spring or autumn 1. PELLAEA Spores at 55-64°F (13-18°C) 11. PLATYCERICM Sow spores as for Cibotium 1. Detach plantlets once distinct "nest" forms 1. POLYPODR'M As for Matteuccia 1. POLYSTICHUM HOLLY, SHIELD FERN SOW SPOTES as for Matteuccia | Take builtils (p.161) from base of midribs III. Divide (p 162) in spring esp-sterile forms like Pulcherrimum Bevis 1. PTERS BRAKE Sow fresh spores at 70°F (21°C) Divide rhizome (p 162) in spring 1. THELYPTERIS Sow fresh spores at 59°F (15°C) Divide (p.162) in spring or summer 1. Woodsia Sow fresh spores at 59°F (15°C) L. Divide (p. 162) when dormant 11. WOODWARDIA CHAIN FERN SOW SPORES AT 59°F (15°C) in late summer or early autumn [ Divide (p.162) in spring II. Take bulbils (p.161) from upper frond surface 1.

# PROPAGATING FERNS FROM SPORES

I Select a frond chere the brown spored Advantum raddianum Eritz Luth i with ripe sporangia (see right). Cut off the frond with a cusor sharp knife. Place it in a clean folded sheet of paper or envelope in a warm, dry place for 2-3 days to collect the spores.







1 NRIPE

RiPE

TOO RIPE



2 Gently tap the spores anto the surface of a sterdized mixture of equal parts peat and sharp sand or two parts sphagmon moss to one of coarse sand in a 3th (8cm) por Cover with clear plastic wrap



3 the appropriate temperature in indirect light. After 6-9 months aft small "patches" of the green prothable that have developed in the sactage.



4 Set the patches up to Mn (2cm)
apart in slight depressions in a
pot of fresh soil mix. Spray with
sterile id water, cover, and place
the pot in the same propagating
environment as before



5 When the young fronds an large enough to handle pot them into cells or travs of most sailless porting mix. Keep in a humid environment, then pot on when small fronds develop.

(Continued from p 159) The sort, or spore-bearing bodies, are visible on the underside of the fronds (see p 159 and above). A few ferns as in Onoclea produce special spore-bearing fronds. Unripe sort are usually pale green or pale brown, with a granular surface. As sort ripen, their color darkens and the sporangia within swell and split to shed the spores. When just a few of the sort are open and are shaggy in appearance the frond is ready for propagation.

To gather spores, place a fertile frond, or section of frond, in a clean envelope and seep in a warm, dry atmosphere. Do not use plastic bags, they encourage dampness and molds. When the spores are released, they have the appearance of dust. Before sowing, they should be separated from any debris such as scale remnants or leaf hairs, which can contaminate the spore culture.

Examination with a hand lens will reveal minute particles of uniform size these are the spores, and the rest is debris. Either use a fine sieve, or tip the mass onto a clean sheet of paper. Hold the paper at an angle of 45°. Debris will travel rapidly down the surface while the spores move slowly; with a little practice, the spores can be kept on the paper while the debris falls off.

Contamination with algae, mosses, and fung) is a major cause of poor viability and death of prothatil. If you are having problems, try sterilizing the spores in a ten percent solution of sodium hypochlorite (standard household bleach) in distilled water

for 5-10 minutes. Drain rinse in sterile boiled and cooled water, and dry the spores on filter paper for 24-48 hours

Green spores, as in Lygodium and Osmunda, have very short viability and must be sown within 48 hours of gathering. Only spores that are brown when ripe can be stored, they may remain viable for 3–5 years if properly prepared. To store spores, transfer to a labeled plastic film canister containing a packet of desiccant, then keep in a refrigerator at 39–41°F (4–5°C).

### SOWING SPORES

The easiest and most successful sowing medium is a mix of two parts sphagnum moss with one part coarse sand. Sterilize a pot with boiling water or ten percent sodium hypochlorite solution (as above) and fell with the mixture, then sterilize it by pouring boiling water over the surface. Cover at once with plastic wrap. allow to cool completely, then surfacesow the spores (see above) thinly. Recover immediately with fresh plastic wrap, or seal the pot in a new plastic bag. Place in a closed case in indirect light. Germinate hardy and cooltemperate ferns at 59-68°F (15-20°C) and tropical ferms at 70-81°C (21-27°F) (see A-Z of Ferns, p. 159)

Within 2–26 weeks, a velvety green haze of young prothable should appear on the surface of the medium. If it is slimy, there may be algal contamination. Some growers recommend discarding such cultures, although often a few ferns survive. If moss grows, weed it out with

iweezers, and water from below with a ten percent solution of potassium permanganate to control the infestation

In the spring after sowing, clumps of young prothallt can be "patched off into sterile, soilless seed mix. Put in a new plastic bag, seal, and grow on in indirect light and closed conditions, until tiny, recognizable fronds appear

Alternatively, leave the prothalli in place and apply a very dilute balanced liquid fertilizer, a quarter of "normal strength, each month. Patching off can then be delayed until tiny fronds of the adult ferns are clearly visible. They are sturdier, easier to handle, and better able to withstand disturbance at this stage.

When the young fronds are growing well, transplant into a tray in souless mix. Water them in carefully and grow on under a bell jar or closed case. Once established, harden off by gradually admitting more light and air. When 2–3in (5–8cm) tall, pot them singly into 2–3in (5–8cm) pots. Grow on in bright indirect light, shaded from bright sun and sheltered from wind. Provide minimum temperatures to suit each species. Most new ferns are large enough to plant out in 2–3 years.

### VEGETATIVE PROPAGATION

The methods of vegetative increase described here will produce offspring identical to the parent fern, providing a means of building up stocks of cultivars that never produce spores or do not come true from spores

### BULBILS AND PLANTLETS

Many ferns produce bulbils, which look like fat, round seeds, some of which develop into plantiets with roots while still on the parent frond. Bulbils and plantlets may develop at frond tips on or under the midrib over the entire upper surface of the frond, or at the base of the midrib. In their native habitats they weigh down the frond to ground level to root and extend the colony.

PROPAGAT NG FROM MATURE BULBILS
Most bulbils mature toward the end
of the growing season, between late
summer and autumn. A bulbiferous
frond may be detached and pinned
onto a tray containing a moist mixture
of soil ess seed mix, or equal parts peat
and sharp sand (see right), where the
bulbils will root If plantlets have
already developed, it is not necessary
to retain the leaflets of the parent frond
(see right, below)

Alternatively, the frond can be pinned down in situ while still attached to the parent plant, so that the bulbils root into the surrounding soil while receiving sustenance from the parent. Once they have 3-4 fronds, detach and pot them to grow on (see steps 4 and 5, right). The young ferms should be large enough to harden off and plant in 3-4 months, or in late spring or early summer outdoors.

in colder climates

PROPAGATING FROM DORMANT BULBILS
The bases of the old fronds of some
ferns, notably Asplenium scolopendrium
and its cultivars, remain fleshy and
green. When detached near the rhizome
and planted, they produce a cluster of
white bulbils near the base that can
be grown on to make new plants.

in spring, lift the parent fern and clean the soil from the base to expose the old, apparently dead, frond bases Snap the frond cleanly away at its point of attachment to the rhizome. Trim away dead material with a scalpel or sharp knife to leave a section about 2in (5cm) long, with green, living material at the base. Insert this upside down, with the green tissue pointing upward just above the surface, into a tray of soil based seed mix that has been sterilized with boiling water and allowed to cool. Place the travin a new plastic bag, inflate, and seal Keep in bright indirect light at 59-68°E (15-20°C)

Within 1-3 months, each leaf base will form green swellings that develop into small, white bulbils. When they develop roots, remove the frond from the plastic bag, detach the bulbils, pot singly (step 5, right), and grow on in a closed case or plastic bag as for plantlets grown from mature bulbils (see above)

GROWING FERNS

I in the automn, select a frond here of Asplemum bulbiferum that is weighed down by bulbils and cut it off near the base. Tiny new fronds may already be emerging to im the bulbils (see inset





Prepare a tray with moist soilless seed mix Peg down the friend on the surface of the mix with wire staples (see inset). Make sure that the ribs of the friend are in close contact with mix started.



3 Water the tray, allow to drain, label, and put in an inflated, sealed, clear plastic bug. Keep in a warm, light place out of direct sun or in a closed case in shade, hardy species at 59-68° [15-20°C], impical ones at 75-81°F (24 ....)

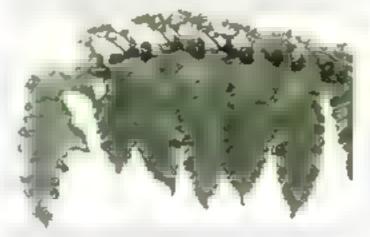


4 When the bulbuls have rooted, take the tray from the bag or closed case and remove the ware staples. Lift each plantlet, holding it by the frond. Cut the new plantlet free from the frond with a knile, if necessary



5 Fill 3m (8cm) pots with moist soillers potting mix Corefully pot individual planticts. Keep in a warm, light place water regularly and give a half strength liquid feed monthly. Por them on as they devel of

### FRONDS WITH ROOTING PLANTLETS



FROND WITH PLANTLETS in some cases, builties develop fronds and root systems while still attached to the parent plant (here of Diplazium proliferum). The frond can be removed and used for propagation.



PREPARING THE FROND Remove not or leaflets and any dead matter on the frond in proching them off. Pin the frond onto a tray of soil mix (see step 2 above) and pot prantlets individually when they show new growth.

### DIVIDING AFRIAL RHIZOMES OF FERNS



I Select a strong, new rhizome (here on a Davallia solida cultivar) with plenty of healthy young fronds. Remove a section 6-12in (15-30cm) long, cutting straight across the rhizome with pruners

### SIMPLE DIVISION OF FERNS

Dividing established ferns is simple and ideal when only a few plants are wanted It may be the only practical means of propagation for sterile forms such as Polystichum settferum 'Pulcherrimum Bevis'. Division sets back the parent and is best done in early to midspring, to give it a full growing season to recover

Ferns that have upright rhizomes each with a crown or "shuttlecock" of fronds at its apex, can be divided to separate side-crowns that form around the main crown. It is essential that the divisions consist of completely intaci single crowns with roots. In some ferns as with Matteuccia struthopteris or Athyrium filix-femina, side-crowns arise 6-12in (15-30cm) or more from the main crown and can often be detached without lifting the parent. With other ferns, lift the plant as growth begins and divide as for herbaceous perennials (see p. 148), separating individual crowns. Trim away dead fronds and any damaged rhizomes, and rub cut surfaces with garden lime to seal the wounds

Replant the parent and large divisions of vigorous hardy ferns at once in their permanent sites, and keep well watered until reestablished. Pot small divisions and those of deficate or tender ferns, in 3m (8cm) pots in free-draining, soilless potting mix containing a slow-release fertilizer. Place in a shaded, sheltered site until new growth appears, outdoors or in a cold frame for hardy species, and under glass at an appropriate temperature for tender ferns. Keep evenly moist but do not overwater. Most can be planted out after three months.

### DIVISION OF FERN RHIZOMES

Ferns possessing rhizomes that creep sideways, either below, at, or above the soil surface, can be divided simply by



2 Cut the rhizome into sections about? 3in (5-8cm long. Trim off the fronds, which may otherwise for Each section should have at least one growth bud (see inset). Longer sections tend to be more successful.

Ringomes are closely spaced but not touching

3 Fill a seed tray with a moist mox of equal parts soil, bank, fine grit or coarse sand and peat. Firm lightly, then gently press or peg the rhizome sections about 1 in (2.5cm) apart into the surface. Labor

4 Keep humid in a closed case, heated if necessary to 70°F (21°C). When the sections are well rooted and are producing frands, usually within 4-6 months, pot then individually into motst, sodiess potting more tabel and grow on in humid shadi.

clean, sharp knife
or pruners in early
to midspring Each
section can be only 2-3in (5-8cm)
long but must have one or more
growing points and a root system. Pot
them individually into soilless poiting
mix, and grow on in sheltered shade
Keep them well watered until they start
into growth, which is usually within

cutting up the

rhizome with a

2-3 months

Terrestrial ferms, such as Phegopteris connectilis or Gymnocarpium dryopteris, usually have their rhizomes beneath the soil, with fronds appearing from the nodes. Growth buds are seldom visible on underground rhizomes. In this case, ensure that each section has 2–3 healthy fronds, and a small root ball at least 2 in (5cm) across, with an intact clump of soil. On short-creeping rhizomes, the nodes are often congested, making short sections difficult to take Slightly larger divisions taken from well-established colonies are most likely to be successful

When dividing ferns with surface rhizomes, as in Polypodium, it is vital that each section has good roots. When replanting or potting, ensure that the rhizome is set at the same level as it was

Many epiphytic and lithophytic
(rock-dwelling) ferns, such as Davalita,
produce aerial rhizomes that will produce
roots and new fronds if severed and
pegged down on soil mix (see above)
in early spring Alternatively, pin them
down on open ground while still
attached to the parent fern and sever
each plantlet when rooted

PROPAGATION FROM STOLONS

Some ferns, for example Blechnum spread to form colonies by subterranean stolons, runners that produce new plantiets at their apex and sometimes at the nodes. Detach young plantlets from the parent colony in spring, ensuring that each has a well-developed root system. Pot into soilless poiting mix with a little added slow-release fertilizer, keep evenly moist, and grow on in a sheltered, shady site. When they are growing well, usually after 2-3 months, plant out. Young plants may be slow to grow, in colder climates, if they have not made good growth by summer overwinter in a frost-free place and plant out in the following spring

Some Nephrolepis have aerial stolons, trailing stems that root where they touch the soil Promote this habit by pinning down stolons during the growing season into 2–3in (5–8cm) pots in equal parts peat or fine bark and sharp sand. Keep evenly moist at 55°F (13°C). In late winter or early spring, when plantlets begin to show growth, detach them from the parent, pot, and grow on

Some species, notably N cordifolia. produce small, scaly tubers at intervals along the stolons. Remove these with a short length of stolon when repotting in late winter or early spring, then treat as above, poiting each tuber with a length of stolon at the same depth as before

### PROPAGATION FROM AURICLES

Ferns in the tropical family Marattiaceae which includes Angiopteris, Christensenta and Marattia, form enormous, upright rhizomes topped by massive fronds up to 15ft (5m) tall. At the swollen base of each frond stalk, they hear a pair of fleshy, earlike growths known as auricles that produce new plants from

dormant buds. They can be induced to root, if detached, to form a new plant Auricles may be detached at any time especially in the tropics, elsewhere, they make most rapid growth if taken in late winter or early spring. Root them in a mixture of peat and sand (see below) or insert the base in moist sand and top with a layer of sphagnum moss to half the auricle's depth. Keep humid in a closed case or under mist at 75–81°F (24–27°C) and in bright, indirect light

It takes 2-6 months (less in tropical regions) before new growth appears. The auricles form visible buds, then roots and finally shoots. In temperate areas, it may take 12 or more months to form plants large enough to transplant. Once fronds are recognizable, pot into a lime-free mix of one part soil, two parts sharp sand, three parts leaf mold, three parts medium-grade bark, and one part charcoal. Keep the plants moist at all times and in high humidits.

### LAYERING

Layering can be used for Lygodium, the climbing ferns. Their fronds arise from a climbing rachis (frond midrib) with nodal joints. When the frond is growing actively, between early spring and early summer, pin a node onto the surface of a pot of moist, sharp sand. Keep it evenly moist, at a minimum of 59–68°F (15–20°C) in bright, filtered light, with high humidity. When strong new growth emerges at the tip of the frond, sever the layer and pot into equal parts leaf mold or peat, soil-based potting mix, osmunda fiber, and charcoal

### SEPARATING OFFSETS

Some tree ferns produce offsets from their trunks (Dichsonia and Cvathea) or from the roots (Cvathea). These usually develop very slowly unless the parent's main growing point is damaged. They can be grown on if severed cleanly from the parent trunk in spring

Center the offset in a pot in a moist mix of one part each of soil, medium-grade bark, and charcoal, with two parts sharp sand and three parts leaf mold. Set it just deep enough so that it sits upright. Place in a closed case with high humidity at 59-68°F (15-20°C), in bright, filtered light. Harden off once the offset begins to show new growth.

I be the water or early spring select a years, we is plant (such as the Angiopteris in the Egyptone projectably with a selly packed nameles at the base. Auricles from manire plants in the background) root less regal.

4 Keep in a warm bright humid place
Adventitious buds should form within 2-6
months. Pot, or plant out, when a strong root
system and small fronds have developed (see
above) usually in 12-18 months

### PROPAGATION FROM AURICLES





2 Remove a healthy, undamaged auricle by cutting between it and the parent rhizome with a clean, sharp knife Fill a 2-3in (5-8cm clay pot with a moist mix of equal parts coarse sand and peat



3 Irin any towar or spage on the mirele (see most and dust the cut surface with funguable insert the auricle base acommunic so that the bottom half is buried below the surface. Water in and tape!

# ALPINE PLANTS

There is much similarity between the methods used to propagate alpines and those used for larger perennials and shrubs. The most obvious difference, and the one that raises most problems. is one of scale. Cuttings are especially small and fussy some may be no more

than Air (5mm) long

The other key difference relates to the conditions alpines prefer. Whether from high mountains or low altitudes. the most important environmental element most alpines have in common is very good drainage. In cultivation including when being propagated, they prefer a growing medium that is waterretentive yet very free-draining. Standard soil mixes are generally unsuitable. Extragnt or sand must be added; pure sand or even ground pumice is used for cuttings of certain plants

### GROWING FROM SEEDS

For many alpines, seeds are best sown the moment they are ripe, not only for those species whose seeds have short viability, such as primroses. Seeds sown fresh in early to midsummer (especially those of Adoms, Androsace, Anemone Codonopsis, Corydalts, Dionysta. Hepatica, Incarvillea, Meconopsis Primula Pulsatella and Rananculus) may germinate in only 2-3 weeks and develop into strong, healthy new plants by autumn. If seeds cannot be gathered or purchased fresh, they are best sown either in winter or early spring

As with other plant groups, the seeds of many species will come true to type but that of many cultivars will not, usually their seedlings will be inferior but, just occasionally, an exceptionally

fine plant may arise. Whenever several plants in the same genus grow in close proximity, hybrids are likely to occur, especially with Aquilegia, Celmisia, Geranium, Lewisia, Meconopsis. Penstemon, Primula, Saxifraga, and Viola.

### GATHERING AND STORING SEEDS

Alpine seeds should be gathered as soon as they are ripe (especially genera such as Geranium and Euphorbia that scatter seeds (ar and wide) cleaned and sown fresh or stored in a cool, dry place, or in an airtight box in a refrigerator

Gathering seeds of cushion alpines often requires patience and diligence (which is why the seeds are scarce and valuable), by the time the fruits are ripe, they may be buried among the new leaf rosettes. You may need a hand lens to locate them, and tweezers to pry leaf rosettes apart gently and to remove the tiny fruits or individual seeds

### PREPARING SEEDS FOR SOWING

Some alpine seeds will not germinate until they have received a period of cold stratification (see p 152-3), simulating natural alpine conditions. In colder climates, winter in the open garden usually provides all the cold that is necessary" pots of seeds can be left in a ventilated cold frame. Winter-sown seeds can germinate quickly, and the seedlings may need protection (see p 45). Alternatively, cheat the seasons by putting seeds in the refrigerator for a time (see facing page), then taking them outside to a cold frame to germinate

Hard-coated alpine seeds are usually far too small to chip or scarify (see also p. 152), but some seeds can be soaked before sowing to aid germination

### SEEDS FROM CUSHION PLANTS



Fruits - capsules - on cashion or ma. Jerming alpines there Androsace hirtell is can be tonand Indden among the new growth. Garber the fruits, capsules, or single seeds using tweezers

especially older, fleshy seeds that have become wrinkled and shrunken in storage, Cyclamen and Tropacolum seeds are good examples. Soak the seeds for 12-24 hours in tepid water (adding a drop of liquid soap helps water uptake), then drain and sow immediately

### SOWING SEEDS OF ALPINES

Hygiene is especially vital with alpines seeds and seedlings are tiny and easily swamped by weeds, liverworts, and mosses. Soil mixes and pots must be clean, if not sterile. A good all-purpose seed soil mix for alpines consists of equal parts of soil-based seed mix or sterilized soil and either fine sharp grit or coarse sand. Use horncultural sand. coastal sand contains salt, which will kill seedlings. If using a peat-based mix, or for alpines that demand very sharp drainage such as Acantholimon and Dionysia, double the amount of grit or sand

### POT SOWN WITH FINE SEEDS OF ALPINES



Social in fine sand

Gritts seed soil mex

Put a layer of broken pots or rock chips in the bottom then fill to within sin (2cm) of the rim with soil mix A good mex is one part peatbased seed mix to two parts fine grit or coarse sand. Water well then allow to drain. Sow the seeds finely over the surface. in a 4in (2. 3mm) layer of fine horticultural sand

### SOWING ALPINE SEEDS



Sow seeds evenly over the surface covering ail but fine seeds (see left) with a little soil mix. Add - Am (5-10mm) of fine grit to protect the seeds Water and label. Transplant seedlings when they produce two true leaves, top-dressing with a Ain (1cm) layer of fine grit (see inset)

### SEED STRATIFICATION



Saw seeds as normal (see facing page, below)
Seal the pot in a plastic bag to keep the soil mix
no.st. Place in the bottom of a refrigerator for
4-5 weeks. Remove the bag and place outdoors.

Thin-sowing is essential, tapping seeds carefully from the hand or packet (larger seeds can be placed individually) Most seeds sown in soil mix need covering with a very fine dusting of mix, but care must be taken not to bury the seeds Very fine seeds can be mixed with dry fine sand to help distribute the seeds thinly and evenly. For such seeds, no soil mix covering is needed. A thin layer. of fine, sharp grit helps retain moisture and suppresses mosses and liverworts and it also prevents the seeds from being washed out by watering or, if pots are in the open, heavy rain. Place the labeled pots in a cool, partly shaded position outdoors, a cord frame is ideal

### GERMINATION OF SEEDS

This varies enormously from species to species it may take place within days of sowing, or anything up to four years later Erratic germination can pose a problem, especially if seeds continue to germinate in the same pot over a period of a year or more Ideally, carefully tease out and transplant early seedlings, then fill in gaps in the seed pot with more soil mix and return it to its previous position to await further germination

### CARE OF SEEDLING ALPINES

Once they are large enough to handle, the majority of seeding alpines should be transplanted carefully. If the seeds germinate in early winter, however, it is best to leave them undisturbed until spring. Some alpines are best left in their seed pots for a year or more

Many alpines develop an extensive root system when they are very young and transplanting must be done with great care to avoid damage. Although in some cases seedlings are only 14—16mm (5—10mm) tall, as with other seedlings, handle only the leaves to avoid damaging the fragile young stems

Transplant into trays, individual pois, or cells, the latter are best for the majority of tufted and cushion-forming alpines Use the same free-draining soil mixes as for sowing seeds. Firm the mix only gently, water it thoroughly, and allow to drain. Make a hole large enough to contain the roots, insert each seedling filter in more soil mix, and firm gent v Cover the mix right up to the neck of the plant with a 4-2in (6-12mm) layer of fine grit. This keeps the surface of the soil mix cool and weed-free but, more importantly, ensures perfect drainage around the neck, which is otherwise prone to fungal attacks

### HARDY GESNERIADS FROM SEEDS

This group, which includes Haberlea. Jankaea, and Ramonda (and, culturally speaking, dwarf rhododendrons), needs special treatment. The seeds are almost dustlike and must be surface-sown; the seedlings are very prone to desiccation and vulnerable to infections. Seeds are best sown as for fern spores (see also p. 160) on live, finely chopped sphagnum

### SOWING SEEDS ON MOSS



1 With seissors on a clean scolace, chop up a few handfals of spherican in its total function 2 3cm2 processed processed as leave gloss or set the as reach great fresh in some possession.

moss (see below) or on sterilized peatbased seed soil mix, then germinated in an enclosed environment

If using soil mix, fill a pot with it and firm, then water with boiling water to sterilize the mix. Allow it to drain and cool, then sow thinly on the surface, as for moss (see below).

Cover the container immediately after sowing, either in a closed case or tented and sealed in a plastic bag, or in a clear plastic container with a lid. Seal a loose lid with tape. Leave in a cool shaded place. The seeds do not usually need watering for a long time, but, should it become necessary, water from below or lightly mist over the top. Do this quickly, the more often the lids are removed and the longer they are left open, the greater the chance of infection with spores of various mosses and funging

The seedlings develop very slowly and should be left undisturbed still in their sealed container until the second or even third year. Transplant them into peat-based mix and gradually wean them from their protected environment.



2 f di the basel with boiling water to steritize
the moss, then allow it to cool Squeeze out
the excess moisture. Place a 1-2m (2.5-5cm
layer of the moss in a small, steritized container



3 Scatter the seeds on top of the moss. Fine seeds can be sown more evenly using a folded piece of paper or cardboard. Seal the container with a lid, then label (see inset). Place in a cool shady place or in a shaded cold frame.



4 The seeds should germinate after 4-6 weeks (see inset) Ventilate the container in removing the lid at regular intervals to prevent damping off Grow on for 2-3 years until the seedlings become large enough to handle

### TAKING CUTTINGS

Cuttings are a good way of propagating many alpines, especially named hybrids and cultivars, which are unlikely to come true from seeds. As with larger plants, stems, leaves, and roots can all be used but the cushion and rosetteand mat-forming alpines all require special techniques. Expensive equipment is unnecessary, since most alpines can he increased with simple methods and some very basic equipment, although tweezers and a scalpel are useful tools for dealing with tiny pieces of plant material. Stem cuttings may be 4-4in (3-5mm) long, but smaller cuttings 76-54 in (1-3mm) long often need to be taken, even smaller for choice Dionysia Saxifraga, and Gentiana

The prime rules for taking any cuttings apply equally to alpines, use very clean, sharp cutting tools, select healthy, nonflowering material, never allow cuttings to dry out, either when preparing them or when growing them on, and keep pests and diseases at bay

Hormone rooting compounds can be helpful, especially for woody alpines such as many dwarf ericaceous plants, daphnes and alpine willows (see Shrubs and Climbing Plants pp 118–145), but many cuttings root satisfactorily without them

A good medium for cuttings of many alpines is made with equal parts of a standard soil-based rooting medium and coarse sand. Even this may not be free-draining enough for certain alpines pure horticultural sand or even ground pumice (see opposite) can be used for difficult-to-root plants such as Dionysia and some Saxifraga.

Most prepared cuttings may be inserted in pots, pans, or trays in suitable medium, sand, or pumice. They should be spaced in rows in trays or around the perimeter of a pot or pan. Label each container and water in the cuttings with a fungicide. Cuttings root satisfactorily

in a sheltered place, usually at 50-59°F (10-15°C) out of direct sunlight. They should also be covered to keep them humid and avoid moisture loss. Suitable sites are a cool, well-lit windowstill under a glass jar or clear plastic bag, in an unheated closed case or shaded cold frame, or even on a bench in a greenhouse or alpine house. Gentle bottom heat of 35-64°F (13-18°C) is not vital, but it speeds rooting.

While the cuttings are rooting and growing on, any that show signs of distress, dving back, or of fungal infection should be removed quickly otherwise the whole batch of cuttings may be affected. Pot the cuttings once they have rooted, this will be indicated by renewed shoot growth or roots appearing through the base of the pot

### STEM-TIP CUTTINGS

These are essentially similar to those taken from larger herbaceous plants. Softwood cuttings are taken from young

The state of the s



1 Select strong, nonflowering shoots there from Gypsophila repens) and take cuttings from different areas on the plant. Place the cuttings in a plastic bag to prevent wilting.

green shoots in active growth in the spring or early summer before the new shoots begin to harden and ripen Greenwood cuttings are slightly more mature; leafy shoots where growth has slowed but not hardened and is still quite soft and sappy. They are taken in early summer. As these shoots mature they become firm, or semi-ripe. Shoots of the current year's growth that are fully ripened and woody furnish hardwood (or from evergreens, ripewood) cuttings of many alpine plants. These cuttings can be taken from midsummer until autumn, depending on the plant.

Trim the cuttings to just below a node (except for Clematis, which should be internodal) and trim off lower leaves close to the stem. Soft growing tips can be pinched out, especially if wilting

BASAL AND ROSETTE CUTTINGS
These are the most important of all
for alpine plants, since many are rosetteforming cushions and carpets. Take the



2 from the cuttings as indicated below, using a clean, sharp knife or scaipel. Fill a pol with gratty rooting medium. Insert the cuttings to the required depth (see below), and from in

### TYPES OF CUTTINGS OF ALPINE PLANTS



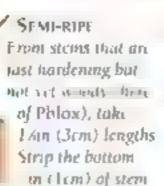
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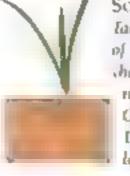
lake new 2-3 n

(5-7cm) shoots

here of Primula)

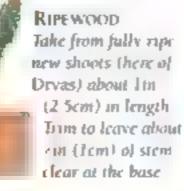
from the paint bese
with new leaves and
a short stem. Trim
base below a node





SOFTWOOD

Take the soft trps
of new green shoots
there of Gypsophila
in delive growth
Cuttings should be
I 3in (2 5-7cm)
long

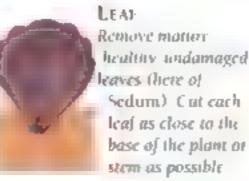




GREENWOOD

lake 1-1m . > on
lengths from soft tips
fiere of Erodium?

when growth slows
down from the
tower in Tem
of the cutting



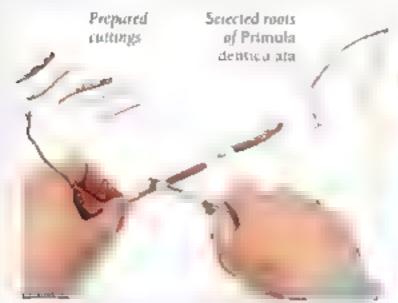


ROSETTE lake new resettes at the plant edges chere of Saxifraga) Cut 2-10mm below the leaves. Trim lower third of stem



SELT-ROOTING
Brush away surface
soil around the edge
of the plant and oft
rooted pieces (here
of Veronica). Trini
off sideshoots and
straggly roots

### TAKING ALPINE ROOT CUTTINGS



I be late autisms, lift a healthy plant. Cut off thick healthy mots close to the crown. Cut each one into 1%—2in (4—5cm) pieces, making an angled cut at the lower end

cuttings in late spring and in summer Handle parent plants with care, for they are easily bruised, and any damage may invite in fungal infections. The cuttings often have very short stems, so they need to be taken and trimmed with care Rosette cuttings are best placed in rows in trays or in pots. Rooting is slow and rather spasmodic

Dionysia is often particularly difficult to root, being prone to rotting off. For these and several other plants (see box, below), some commercial growers advocate using crushed pumice instead of rooting medium (see below). Cuttings will require only occasional watering. This is best accomplished by placing pots in a deep tray of water for an hour

### SELF-ROOTED CUTTINGS

Many alpines form mats or tufts that root down at intervals or produce creeping, rooting stems (runners) or



2 Put drainage material in the base of a large half pot Fill with rooting medium. Insert the cuttings so the straight ends are flush with the surface. Layer Sin (1cm) of fine grit on top

rhizomes. Removing rooted portions is simple and has the advantage of not disturbing the parent plant unduly. Take the cuttings in late spring and summer when the plants are in active growth by cutting off pieces with a sharp knife Self-rooted cuttings do not need to be covered once potted

### **LEAF CUTTINGS**

A few alpines can be propagated from single leaves, particularly those that have firm or fleshy foliage; summer is the best time. Selected leaves should be mature and healthy with no sign of dieback or yellowing. Insert the bottom quarter or third of the leaf upright in the medium, or preferably at 45° (with the upper leaf surface uppermost).

Water sparingly until the cuttings root to avoid the possibility of rot. Pot on each cutting once new leaves or shoots appear at the base of the leaf

### ROOT CUTTINGS

A few alpine plants, including Anchusa caespitosa, Morisia, and Primula denticulata, can be grown from root cuttings (see left and p 158) Select only the thickest and healthiest roots. The best time for this is in late autumn and winter Pure sharp sand is an alternative to rooting medium for some plants. Keep slightly moist, but not wet. Pot cuttings once new growth appears.

### DIVISION

Many alpine perennials, including some alpine Dianthus, can be propagated by simple division, in the same way as their larger relatives (see p 148). Being smaller, alpines need to be handled with greater care; some easily fall apart when lifted Most suitable are those alpines that form clumps with a mass of fibrous roots, such as alpine Achillea and Campanula, Arenaria, Celmisia, and Gentiana acaulis Unsuitable for division are the majority of cushion alpines (cushions are easily ruined by lifting), particularly alpines with a central crown or a simple taproot, such as Androsace and Dionysia.

Lift plants in early spring as growth starts, or after they have flowered Remove some of the soil to expose the roots. Tease the plant apart into sizeable pieces, ensuring that each separated portion has plenty of sustaining roots Replant immediately if planting in the same area, first work over the soil lightly and add some compost and bonemeal Smaller portions that inevitably separate, or larger pieces with few roots, can be

potted as for cuttings and grown on under cover, for example in a cold frame, until well established

### ROSETTE CUTTINGS IN GROUND PUMICE



I Select a healthy resette from the edge of the plant (here Dionysia are in des Steats the resette with tweezers and cut the stem - n (5-10mm) below the shoot up

### PLANTS TO ROOT IN PUMICE

Androsace (syn. Douglasta)
Small cushion species. A.c.hata
A. cylindrica and A. vandeili.
Celmisia. C. sessinflora



2 Carefully trim off the lower lind of each rosetic (see inset). Dip the base of each cutting in hormone rooting compound.

DIONYSIA especially D curviflora.

D tapetodes. D microphylla,

D freitagn

Draba D rigida var bryoides,



3 fill a 2m (Sem) clay pot with ground pumice to within on (1cm) of the rim. Water from below and allow to drain, insert cuttings ain (1cm) apart. Firm and label

D mollissima Gypsophica G arctioides Myosoriis M pulvinaris Raoulia All species

### **GROUND PUMICE**



Finely ground pumice, derived from icelandic volcanic rock is totally sterile and is sufficiently water-retentive for aipines. It is available from alpine suppliers in some areas

SAMERAGA Small, rare, cushion types, especially softer types

S. cebennensis, S. oppositifolia,

S. polunimana, S. pubescens

# Water Garden Plants

True aquatic plants are those that grow with their roots, and often part or all of their topgrowth, permanently submerged in either water or saturated soil. They include bog plants such as Lysichiton, which thrive in waterlogged soil marginals (such as tris laevigata) which grow in shallow water, water weeds such as Myriophyllum, submerged plants that help oxygenate the water deep-water floating-leaved plants such as waterlifes (Nymphaea); and surface-floaters (for example, Pistia stratiotes) whose roots trail freely, absorbing nutrients from the water

### METHODS OF PROPAGATION

Most aquatic plants reproduce readily by vegetative means. Many multiply by producing new plantlets, either on floating stems or from questing roots. In tropical and subtropical areas especially certain aquatic plants (such as the water hyacinth, Eichhorma crassipes) thrive so well that they are regarded as invasive weeds and even clog waterways

In small ponds, plants must be thinned and divided regularly to avoid crowding, and this may result in more plants than the pond can accommodate Replant only the younger and most vigorous portions and discard old unproductive parts to rejuvenate the entire planting. In garden ponds, aquatics may be grown in meshed planting baskets, which makes it easier to lift and divide clump-forming plants such as some Cyperus, and rhizomatous

plants, such as cattail (Typha)
Standard plastic pots with many
drainage holes may also be used
Free-floating plants and loosely
rooting submerged weeds can be
thinned and separated by combing
or netting them from the water

Other propagation methods, such as seeds or cuttings, often require more aftercare, with new plants needing to be raised in controlled conditions that mimic their growing environment

There are special, soil-based aquatic mixes available for water garden plants but a heavy soil or soil based potting mix is also suitable.

### DIVISION

Division is certainly the simplest means of increase for fibrous-rooted plants such as sedges and other marginals, plus certain tuberous and rhizomatous plants including waterfiles Plantlets may be separated from many aquatics without lifting the parent In general, divide plants in active growth, preferably in late spring, so that the wounds heal quickly. With some exceptions, it is best not to divide dormant plants, because low water temperatures increase the risk of rot

Take care not to increase algal blanket weed in the process, tiny traces of it are easily overlooked, so thoroughly wash the stems, foliage, and roots of divisions to ensure they are free of fine algal filaments before you replant

# Contail the spring I be a motion Jump when the leaves begin to appear Dip the plant in water and carchair wash the soil from the roots

DIVIDING WATERLILIES

2.2 I growth bads. Trim away any damaged or overlong roots. Pot each section and keep in shallow water until they show signs of growth.

Distant

this one

del secreto

### A-Z OF PLANTS FOR THE WATER GARDEN

Acords Divide rhizomes in spring I
Acords Water Plantain Divide rhizomes
in spring I. Sow seeds fresh or store dry for
spring sowing at 59°F (15°C) II
Aronogeton Divide rhizomes in spring,
grow on at 59°F (15°C) I. Sow fresh seeds
at 59°F (15°C) I
II That's Elowering Resit Water Glabioit's
Divide in early spring grow on buildis I.
Sow fresh seeds at 59°F (15°C) II

CALLA BOG ARL M. Divide in spring J. Sow Iresh seeds at 50°F (10°C) II. CALTUA MARSH MARIGOLD Divide in late summer or early spring J. Sow fresh seeds at 50°F (10°C) I

Cyperics Divide in spring I. Planifets in summer I. Sow seeds in spring, tender species at 70°F (21°C) II. Take cuttings when in growth I. Elembornia Water reactive Detach

**EICHHORNIA CRASSIPES** 

offsets in summer, overwinter at 45°F (7°C) I Houtzersia. Divide rhizomes or plantlets in spring I. Sow seeds fresh at 50°F (10°C) II Take cuttings in late spring I Hydrociums Procest. Plantlets in spring or

summer 1. Sow seeds fresh at 50°F (10°C) 1

lars Divide rhizomes after flowering 1. Sow
seeds fresh at 50°F (10°C) 1

LAGAROSPHON (syn Elodea) Take cuttings in spring or early summer L. Can be invasive

LISICHTON Divide in spring dice

Bowering J. Sow seeds fresh or in

spring at 50°F (10°C) JJ

VENTRA AQUATICA WATERMINI

Divide in spring or

autumn J. Sow seeds

in spring at 50°F (10°C) J

Cuttings in spring or summer J

MENTANTHEN TREGULATA BOURT AN

Divide in spring J. Sow seeds fresh at

50°F (10°C) JJ. Cuttings in spring J.

VELLARO LOTUS Divide in spring J.

Sow searthed seeds at 77°F (25°C) in

spring JJ

Action Yellow forth the Divide in spring 1 NYMPHAEA WATERING Divide in spring I Plantlets in summer 4. Sow seeds fresh or in spring, hardy species at 50-55°F (10-13°C), tropical ones at 73-81°F (23-27°C) & Rootbud cuttings in spring or early summer 1 Orosation Golden Clob Divide in spring 1. Sow seeds fresh at 50°F (10°C) 11. PETTANDRA ARROW AREM Divide in spring 1 PISTA WALER LETTUCE Planters in summer 1 PONJEDIAM P CREATE WEED OR ROSH. DIVIDE IN tate spring I. Sow seeds fresh at 50°F (10°C) II POTAMOGETON As for Lagarosiphon | RANENCE EUS AQUADIUS, R. LINGUA. Divide in spring or late summer 1. Sow seeds Iresh at 50°F (10°C) 11. Cuttings after flowering 11. SAGITTARIA ARRAWHEAD Detach papillets or tubers in spring & Sow seeds fresh at 50°F (10°C) II

STRATIOTES ALOTDES Detach plantlets in summer or turions in autumn 1.

Tipha Cattail Divide in spring 1.

Victoria Giant waterlift Sow seeds in winter or early spring at 84–90°F (29–32°C).

### DIVIDING CLUMP-FORMING PLANTS

Some clump-forming perennials, mainly marginal plants such as sedges (Carex) may be simply lifted and pulled apart by hand as for any fibrous-rooted perennial (see p. 148). Lift the entire clump, then pull or cut off sections, about a handful in size, with good roots. Discard the older, central part of the clump, then replant the new divisions.

Small divisions may be potted to grow on until established, place the pots in a larger container filled with water up to the level of the soil mix. Keep frostfree over writter where necessary

### DIVIDING RHIZOMES AND TUBERS

A number of water garden plants have rhizomatous or tuberous roots. Divide these in spring or early summer. Hardy waterlilies (except for Nymphaca tetragona, which is raised from seeds) are often increased in this way, but even if you do not need to increase stocks, it is a good idea to lift and divide waterlilies every few years to rejuvenate them. Some have a roughly conical rhizome around which new growth points develop; you can cut away as little as a single one of these with a sprout of leaves and some tibrous roots to pot and grow on (see

facing page) Rhizomes of other waterlines such as N odoraid and N tuberosa extend horizontally, with sprouts of leaves and roots at intervals. Although they look different from conteal rhizomes, the principle is the same. Cut the rhizome into sections, each with some leaf and root growth attached.

Replant the divisions in containers just below soil level, in fresh aquatic soil mix. Return large divisions to their permanent positions. Raise them on bricks to enable the young stems to reach the surface and gradually lower them as the stems grow. Keep small divisions frost-free over winter under shallow water, just deep enough to allow their stems to float freely. As the new growth appears, gradually increase the depth, always ensuring that the tips of the shoots and the unfurled leaves are at the surface.

All rhizomatous and tuberous aquatic plants are divided in much the same way. Some rhizomes are easy to pull apart by hand, but with others you will need a sharp knife. Irises, often divided in autumn, usually require cutting. Make sure that each division includes a section of rhizome with roots and a fair of leaves, as for garden irises (see p. 149). Irim back the leaf fair to about 3-4111, 8-10cm), then replant

Many aquatic plants produce young

Many types of free-floating plant

plantlets, these may be detached from the parent and grown on independently

reproduce in this way, developing offsets

quickly root into muddy shallows. Some

that detach naturally and float away or

form clumps of rosettes, such as Pistia

break off the offsets (see above left) to

SEPARATING PLANTLETS

### DETACHING OFFSETS





Place the plantlet in the

shoots should soon develop.

### SEPARATING WATERLILY PLANTLETS



I then flowering, select a healthy plantlet with well tooms. This one has lorneed on the flower seem, but other wateriday produce plantlets at the bases of the leaves. Pull the plantlet up and away from the rest of the plant. The stem should break without much resistance because it begins to rot and the plantlet starts taking up nutrients through its oven roots.

hasten the process Other plants, such as Stratiotes alordes and some, mostly tropical, waterliftes, form plantlets on long flowering stems that must be severed (see left). Some tropical waterliftes may produce a plantlet on almost every leaf, at the top of the leaf stalk, that may even bloom while still attached to the parent. You can detach the plantlet easily once the leaf starts to disintegrate, or root it by pinning the leaf down onto a pot of aquatic soil mix as for other perennials (see p 150) Either detach the leaf from the parent and keep the pot in shallow water or position a pot under the leaf and allow it to root before cutting it free

The dwarf paper reed, Cyperus papvirus 'Nanus', forms plantlets in its flowerheads. Encourage these to root by bending the stalk and burying the flowerhead in a partly immersed container of soil. Once the plantlets root, they may be divided and potted separately to grow on



2 These plantlets are from flowering shoots, they are at differing stages of development but can all be grown on to form new plants. Irim off the old flower stem and any damaged material. Fill a basket or large pot with aquatic soil mix or heavy sou



Insert each plantiet up to its crown in the soil mex and secure them with win hoops. Cover with a thin layer of gravel leaving growing points exposed (see inset) then label. Grow on in shallow water

### GATHERING AND SOWING SEEDS OF WATER GARDEN PLANTS



I Gather seeds from ripe seedheads in summer or autumn. Cut off dry capsales (here of tris nevigata) and break them open. Seeds should be sown immediately upon gathering; if this is not possible, store them in vials of water



2 Fill a Sin (13cm) pot with gently fremed aquatic soil max or soil based potting mix, then sow the seeds evenly over the surface Cover with a sin (500m) layer of fine gent this will help retain moisture. Label



3 Stand the potent a large bowl that is a little deeper than the pot. Add water to the bowl until it just covers the pot. Place in bright light a the appropriate temperature for the piam until the seeds germinate (see inset.)

### SEEDS

Raising aquatic plants from seeds can be quite a slow process, with some taking 3-4 years or more to reach flowering size, but it is useful if you require a large number of plants or where it is not possible to take divisions or cuttings. It is suitable for many plants that are valued for their flowers, such as waterlikes, lotuses (Nelumbo). Appropriate Appropriate As with other plants, seeds of cultivars may not come true to type

### GATHERING SEEDS

Gather seeds of water garden plants as soon as they are ripe in summer or in autumn. It is best to sow the seeds immediately, but if necessary they may be stored in vials of clean water in a cool, dark place for sowing in spring Storing seeds in moist peat is not recommended. Seeds of only a very few water plants, such as Alisma and Mentha, can be dried for later sowing

Some plants set seeds freely, such as the water plantain (Alisma plantago-aquatica), while others, such as cattails (Typha), may yield fertile seeds only occasionally or, as with tender water-lilies, only in warm chinates. Some water plants bear fruits or berries, which must first be macerated to extract the seeds (see pp. 151-2)

With the exception of Nymphaea tetragona, hardy waterfilies set seeds infrequently, while tropical kinds generally seed freely. To save seeds, enclose a pod in a muslin bag (see above right). Never let the seeds dry out, sow them by smearing them in their aqueous jelly over the surface of the growing medium. Wash off the jelly if you wish to store the seeds over winter.

### GATHERING WATERLILY SEEDS



to harvest the seedpods, wrap some must reloosely around the bud as soon as the flower tades. Secure it with twine around the stem to heep the seed mass much as it sinks to the bottom. The seeds are held in an aqueous jelly that disperses as the seedpod ripens and disintegrates (see right). Retrieve the seeds after 2–3 weeks.

### SOWING SEEDS

First prepare pots or deep trays with aquatic soil mix, soil-based potting mix, or sieved garden soil (see p 152). Do not add fertilizer, because it encourages algal growth, which could smother the seedlings. Sow the seeds evenly on the surface and cover with their own depth of fine grit. Seedlings need wet soil, so stand the pot or tray in a larger container of water so that it is partially submerged or just covered, as in its natural habitat (see top of page). Seeds of hardier plants may germinate without artificial heat if covered with

a sheet of glass raised enough to allow air circulation, in a bright, sheltered place. Less hardy species germinate best at about 59°F (15°C), tender species at 70°F (21°C) and above. Some germinate more readily with gentle bottom heat.

RIPE POD

POD

UNRIPH

POD

When the first pair of true leaves appears, transplant the seedlings into individual pots (see p. 152), then immerse them in water as before under glass, protected from cold if necessary, for another year. Transfer the young plants to their permanent positions once the water has warmed up in spring

### HYBRIDIZING WATER GARDEN PLANTS

Species of waterlihes and water inses may produce some pleasing seedlings if hybridized (see also p.21). To keep seeds pure, transfer pollen from a two or three-day-old bloom to the liquid in the center of a waterlily bloom that is on the point of opening. Protect the poliniated flower from insects by enclosing it in muslin

### **CUTTINGS**

Most submerged aquatics do not develop woody stems, so all cuttings are of soft growth, best taken in spring or summer Fast-growing submerged plants, for example Lagarostphon and Potaniogeton crispus, should be regularly replaced by young stock raised from cuttings

Cuttings are usually softwood stemtip cuttings, prepared in a similar way to other perennials (see pp 154–5). Take cuttings material by pinching or cutting off healthy, young shoots. Remove the lower leaves from cuttings of marginal plants. Trim rosettes as for Cyperus (see below). Cuttings of submerged plants. can be tied mio bunches of six and either potted or thrown into middy wildlife ponds to root. Root cuttings of other plants singly, for example of water mint (Mentha aquatica) and water forgetme-nots (Myosotis scorpioides). Insert the cuttings into pots or trays in soil, then submerge them in shallow water in a warm, shaded place. Cuttings of marginals will root in jars of water (see p.156). You may be able to plant out rooted cuttings after 2–3 weeks.

### ROOT-BUD CUTTINGS

When you lift thizomatous or tuberous plants from the water, or buy them bareroot, you may see small, rounded swellings with emerging shoots on the 
roots, these root buds, also called "eyes," 
may be used for propagation. With 
tuberous waterblies and plants such as 
Acorus, pare out just the root bud with a 
sharp knife (see below). With rhizomes, 
such as Nuphar, take a 3-4in (8-10cm) 
section as well as the growing point

Pot the buds in pots or seed trays Keep submerged under glass as for seeds (see facing page), potting on as necessary and raising the water level as the shoots grow (keeping the tips at the surface) Keep cool but frost free over winter; transplant as growth begins in spring

### **NEW PLANTS FROM WINTER BUDS**

Some aquatics, such as Hydrocharis and Hottoma, produce nodulelike root buds, called winter buds or turions. As the parent becomes dormant in early winter, these naturally float free and sink to the bottom where they stay until spring. Then, the winter buds rise to the surface and develop into new plants. To facilitate this process, detach the winter buds and pot them (see below left). In spring, when the emerging buds float to the surface, gather them and pot into containers in soil or aquatic soil mix.

### BULBILS

Certain rhizomatous plants, such as Butomus umbellatus, form bulbils on the rhizomes, which are similar in function to root buds. Bulbils may be detached and potted (see below) to grow on

### PREPARING ROSETTE CUTTINGS



Select a new, fally mature leaf chere of Cyperus myosucratus) and cut the stem 2m. Sem) below the msette. Hold the rosette in one hand and two the tops of the bracts (see inset) with sharp seissors. Pot the cutting

### TAKING ROOT-BUD CUTTINGS



I Cut out the sworld took bud with its growing point from the morstock. It may be necessary to cut through the neignboring leaf stalks to preserve the bud. Use a sharp kinde fungal injections are less likely to enter clean cuts.



2 fell a 4in (10cm) basket with aquatic soil mix or sifted topsoil. Press in the bud (see inset) so that the growing tip (s just visible top-dress with coarse grit to hold it in place humorse so the grit is just below the water

### WINTER BUDS (TURIONS)



At the end of the growing season, detach the winter buds from the parent plant (here frogbit, Hydrocharis morsus-ranae). Cover with their own depth of soil mix in a pot and keep the pot covered with 6in (15cm) of water. Keep cool, but frost-free, over winter.

### PROPAGATING FROM BULBILS



In spring, when dividing marginals (here a flowering rush, Butomus umbellatus), carefully pry off bulbils (see inset) from the rh nomes. I se your thimbiail and take care not to snap off the bulbil tips, which are soft.

2 aquatic seeds (see facing page). Cover the bulbils with their own depth of soil mix in a small pot. Put the labeled pot in a bowl with enough water to cover the soil mix. Place in a bright place at about 59°F (15°C). The bulbits should root in 1-3 weeks.

# BROMELIADS

These evergreen perennials may be L terrestrial, saxicolous (cling to rocks), or epiphytic (cling to trees) and originate mainly from tropical regions of the Americas. Habitots range from desert to rainforest. Many are rosette- or urnshaped, with central "vases" that trap rainwater Some epiphytic Tillandsia (known as airplants) lack vases and obtain water from the air via minute spongelike, silvery scales covering the Ioliage A few (xerophytic) species are cactuslike, thriving in and, dry deserts

The more popular bromeliads, such as Billbergia, Neoregetta, and Tillandsia, are neat, decorative plants that in cold climates make attractive greenhouse conservatory, or indoor plants. In warm regions, they may be grown outdoors and are used for landscaping in tropical countries. No bromeliads are frost-hardy although a few, for example Dyckta, Heenta, and Puya are nearly so

Propagation is usually by division of offsets - the fastest and easiest method

and for most people the only practical one, since seeds are of short viability and rarely available unless set by your own plants. Bromeliads need lime-free soil and water. If tap water is alkaline, use clean rainwater or cooled boiled water for both mist-spraying and watering. If alkaline water is used for spraying, the calcium deposits will mark the leaves

### DIVISION

The natural cycle of a bromeliad is to reach maturity. flower once, and then die. Offsets form around the base of mature plants, and after flowering the parent persists for a year or so, while the offsets draw nourishment from it In this way, a large clump builds up from several generations of offsets

In cultivation, growers often detach offsets far too early, in order to neaten a plant. These small, immature offsets are very slow to root and require intensive care Removal is often difficult when

they appear between leaves, as with some Tillandsia and Cryptanthus. Treat immature offsets like unrooted cuttings (see below), growing them on in high humidity at a constant 70°F (21°C)

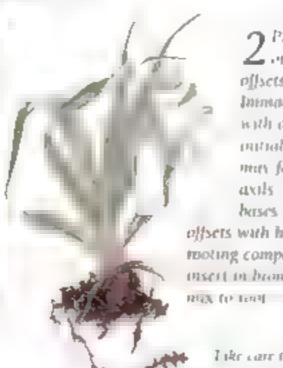
It is far better to leave offsets attached to the slowly deteriorating parent until they reach two-thirds of their full size, by which time they will have established an independent root system. This is especially true for Vriesen splendens and its close relatives, which produce just one offset in the center of the vase; the only way to detach it for propagation is to peel off the leaves that form the vase, destroying the parent

The best time to divide offsets is soon after growth starts in spring. Knock, he clump out of its pot and divide it (see below), discarding the remains of the parent and potting the offsets singly A flowering-sized plant can often be had within a year. Use much the same technique with airplants and other epiphytes mounted on cork bark or

### DIVISION OF TERRESTRIAL BROMELIADS



1 Lift a plant with mature rooted offsets (here L Cryptanthus practextus) or looch it out of its put. Wear gloves, if necessary. Gently pry apart the offsets, discard the old woody center



🚄 or por to bold offsets singly Immuture offsets with only took outrabitisce misers mer form in leaf axils treat the bases of thesi offsets with hormone moting compound and insert in bronicital scal

Plant vac

Like care to preserve any roots



That rooted offsets, prepare a pot 3 with a soluble soft move such as equal parts of soil-based mex-course back, and promee granules, inserthe offset firm gently, water in, and tabel

### DIVISION OF EPIPHYTIC BROMELIADS



Most epiphytic bromeliads produce offsets Lat the base of the plant (here Neoregelia carolinae) Select mature offsets that have begun to farm roots for propagation



Remove an offset, cutting straight across L the base of its stem. Dust the cuts with Linguisde. Wire the offset onto a statable mount to mot or pot as for a terrestrial (see above)

### OFFSETS IN LEAF AXILS



The offsets of some home ands overe Tillandsia cyanea) form in the leaf axils Strip off the outer leaves to expose the base of a mature offset, then gently pull it away

### GATHERING SEEDS FROM BROMELIADS



BERRIES Leave the berries then of an Acchmea hybrid) on the plant and they start to fall naturally, so the seeds are fully ripe Pulp the berries temove the seeds and wash them in warm water with a little detergent added to clean off the sticky coatang

driftwood, where offsets are much more accessible. Leave them in place until they are two-thirds of the parent's size. They are ready for division when they

**GROWING ON ROOTED OFFSETS** 

Rooted offsets from terrestrial species should be potted, as may a number of epiphytes such as Aechmea, Billbergia, and Neoregelia if it suits the grower A very free-draining soil mix is vital to avoid rot. Try equal parts of peat and coarse sand with a little added horncultural charcoal, or equal parts of peat, perlite, and coarse sand

will come away easily without pulling

Humidity is also essential keep the vases of offsets filled with water especially during summer, but take care not to overwater the soil mix. Epiphytic offsets can also be wired onto driftwood, cork bark, or tree-fern stem. Wedge airplant offsets in crevices on branches

### SEEDS

Raising bromeliads from seeds is rewarding for the gardener and is used for mass production and hybridization at nurseries. However, many bromeliads are self-sterile, unless two or more plants of the same species flower simultaneously, it is rare for viable seeds to be set in a small collection. Many Tiliandsia, such as T butzii are self-fertile so are most likely to set seeds.

Bromeliad flowers appear at various times from the vases of mature plants. With some plants, such as Guzmania sanguinea, Neoregelia carolinae 'Tricolor', and Tillandsia ionantha, the top leaves of the rosette turn red when the plant is about to flower. In the wild, flowers are pollinated by hummingbirds, bats, and insects so are best hand-pollinated in cultivation to encourage seeds to set.

Seeds may be contained in papery capsules that split to disperse plumed or winged seeds on the wind. Others are carried in berries and have a jellylike covering (this makes the seeds stick to tree bank when birds wipe their beaks



The papery capsule opers to reveal a fluffy seedhead there of Tillandsia tectorum.) Seeds are fully ripened when the plumes lift effortlessly from the stalk ready to float on the are Sow the seeds with the plumes attached (see below.)

while eating the fruits). Tillandsia seed capsules take from six months to a year to mature, the plumed seeds are ready for gathering within a few days of the capsules opening (see above right). Berries should be left on the plant until fully mature (see above left), then the seeds carefully separated from the flesh and any jelly coating washed off before sowing, since it may inhibit germination

### SOWING SEEDS

Bromeliad seeds should be sown fresh because they are viable for only a month or two – or a few weeks for plumed seeds. Professional growers sow onto orchid seedling mix, which has a very small particle size. Many freedraining, fine, sterilized seed soil mixes are also suitable, as are the mixtures recommended for offsets (see above)

Scatter seeds thinly over the surface of a prepared tray of mix, leave seeds from berries on the surface, but anchor plumed or winged seeds with a very fine layer of coarse grit. Cover with a sheet of glass to retain humidity and sheets of styrofoam to retain warmth and give shade. Minimum temperatures for germination are 66–81°F (19–27°C)

Gardeners may also sow epiphytic seeds onto bundles of conifer twigs, which are slightly acidic (see below), or push them into crevices in fir cones

Bromehad seedlings grow and form roots very slowly, in many epiphytes the original roots disappear some time later. Allow at least five months between sowing and moving on the seedlings. Transplant to about 1 in (2.5cm) apart and grow on close together in trays (except for airplants). This creates a more favorable growing environment than potting small plantlets individually Seedlings may be transplanted several times before potting.

When they are large enough to handle, pot seedlings singly. Epiphytic seedlings may also (continued on p 174)

### SOWING SEEDS OF EPIPHYTIC BROMELIADS



I lake some twigs from a conifer, such as a express or jumper, and make into a bundle with a little moist sphagnum moss. The the bundle with twine raff a, or win



3 sprayer to lightly water the bundle Label the bundle and suspend it lightly in a shaded, warm place with 100 percent hannel iv, such as a closed case or mist propagation bench keep the bundle moist by mist-spraying it regularly, or daily submerging it in clean rain water



2 Pull apart freshly collected, flufty seedheads here of a Tillandsia) and scatter the plumes evenly over the hundle. They should adhere to the moss or can be fied in with more ratha.

### SOWING IN A CONTAINER



Prepare a seed tray or pot with free-draining mix, such as equal parts peat perlite, and coarse sand. Spread the plumed seeds over the surface. Cover with a thin layer of grit to keep the seeds in contact with the mix.

(continued from p.173, be transferred to pieces of tree-fern stem or cork bark

potting mix for all seedlings. A fine grade of orchid mix equal parts of peat and coarse sand or equal parts of peat perfice and coarse sand is best for the first potting. Coarser orchid mixes combined with a little coarse sand can be used for potting on larger plants. Use a standard or even tailer pot to provide excel ent drainage. At all stages, it is vital plants are not potted too deeply the lower leaves should be totally clear of the mix. It usually takes three years or more for new plants to flower.

### OTHER METHODS

The long, rootless strands of Spanish moss (Tillandsia asneoides) can be propagated by perhaps the easiest of all cuttings, simply snip about 12in (30cm) from the end of an established clump, hang it up in the warm, humid conditions in which the plant thrives naturally and allow to grow on

Ananas, including edible pineapple and miniature decorative cultivars such as A contosis Variegatus produce fruits after the flowers on the stem that emerges from the center of the mature vase. At the top of each mature fruit is a tuft of foliage that may be sliced off and rooted (see right) (Fruits retailed in stores may have had the growing tip removed to prevent them from being propagated.)

Pineapples can also be increased from shoots that develop in leaf axils called suckers when they appear low down on the main stem and slips when they arise on the fruit stem see top right). They do not develop if left on the parent but can be detached and rooted for new plants.

### PROPAGATING PINEAPPLES FROM CUTTINGS



Select healthy sups or suckers

or he not be he trust see early

at he hase the sum through any

the sea the street has end

by the en sartae single tag ente

A lose that you after any traffic and most te

outlangs in pass it sinds a most te

cuttags in pass it sinds a most

see he one arrowers. "Million pass

when the chart ton 15cm pass

when the chart ton 15cm pass



### PROPAGATING PINEAPPLES FROM CROWN SHOOTS



I se a shrip ho to to scoop and the crown shoot of a ripe parcapple with about the class of the fra cattached D p the wound in fungicide and allow to dry for several days.



2 Insert the cidency not a pet of motory me hior and he plat a minimum man temperature 1 21 27 C. The cidency should root and be ready to pot on within a few weeks

### A-Z OF BROMELIADS

Angeste our a Terrestrial divide affsets in spring or summer 4. Sow winged seeds to spring at 81°F (27°C) 111 AFCHMEA Emphyte; divide offsets in early scottner. Sew seeds from berries as soon as ripe at 70°F (21°C) 111. ANANAS PINEAPPLE Terrestrial, foot support suckers or crown shoots, see above, at any time 1. Br ack as Epiphyte divide offsets in summer 1. Sow seeds from berries as soon as ripe at 81°F (27°C) III. Bu Mac a Terrestran divide in late spring or early summer 1. Now seeds as for B librigid III. CANISTRUM As for Billbergia.

t it was Epiphyte divide offsets in late spring bottom heat aids Dotting I bow plumed seeds as soon as ripe at 81°F (27°C) 411. CRYPTANTHE'S EARTH STAR, STAREISH PANI Tetresimal detach offsets from leaf axils in early summer 1. Sow seeds as for Bilibergia \$41. x Crypthergia Terrestrial, divide offsets in spring 4. Dy Kia Terrestria, xerophyte d vide in late spring or early summer 1 50w winged seeds in early spring at 81°F (27°C) [44. EASCICULARIA Terresarial, epiphyte verophyte divide offsets in spring or summer 1. Sow seeds from berries in winter or spring at 81°F (27°C) [[].

offsets in midspring 4. Sow plumed seeds at 8. 1 2°C in midspring III. HECHIA Terrestrial, xerophyte; d side illsets in spring & Sow winged seeds as soon as ripe at 70-75°F (21-24°C) 111. NEOREGELIA (syn. Aregelia) Terrestrial epiphyte ovide offsets in spring or summer l Yew seeds from bernes as soon as ripe at 81°F (27°C) [[]. NIDULARIUM BIRD'S NEST BROMELIAD Epiphyte, as for Normgetta ORIHARIA VI Saxacolous divide offsets in spring \ \ow seeds as for Billbergia III.

G was a Epiphyte front

Per agenta Terres rial a vide offsets in late spring or early sammer I sow winged seeds in spring at 66-75°F (19-24°C) 111 Pura Terrestrial, sow winged seeds as soon as ripe a 66-75°F (19-24°C) III. QUESNELIA Terrestrial epiphyte, as for Neoregelia To LA DAM AIR PLANT Epiphyte divide offsets in spring L Seeds as for Binbergia 11. Take cuttings. of T usneedes at any time 1 VRIESIA Epiphyte, divide offsets in spring 1. Sow seeds as for P teatrnia III. WATER A KA Terrestrial epipliste offsets in spring or summer 4 Sow seeds as for Pitcatrina III.

cities in the garden or

If a narsery bed or

# ORNAMENTAL GRASSES

rass, in the form of a closely mown I lawn, has long been valued for its durability but has often been regarded as merely a foil for more interesting planting. Yet the grass family includes an extraordinary diversity of ornamental plants. Some species are valued for their architectural form, such as Miscanthus sinensis, others for their foliage color including glaucous blue fescue (Festuca giduca), for variegation, such as greenand-white striped gardener's garters Phalaris arundinacea Picta) for attractive stems, for example the Chilean bamboo (Chusquea culeou); or for their flowerheads (inflorescences) such as the feathery heads of Cortaderia selloana

True grasses belong to the Poaceae family and almost always have hollow, rounded stems, with solid nodes at regular intervals. This is most obvious In woody-stemmed bamboos (subfamily Bambusoideae) Rushes and sedges look similar but are not true grasses, they belong to other botanical families

Flowers are borne in spikes, panicles or racemes. Many grasses flower when two years old or so, but bamboos remain vegetative for decades. They will eventually begin to flower at first, only a few canes will have inflorescences. but these will increase in number quite considerably in subsequent years. Once flowering begins, a bamboo will decline in vigor and then often die

### PROPAGATING PERENNIAL GRASSES

Perennial grasses are common plants and in some cases, can be invasive weeds, so it is often assumed that they are easy to propagate. They can be, provided that a few basic principles are followed. There are two main methods of increase: by division or from seeds

Division must be used to increase all bamboos, which rarely flower; variegated grasses, which lose their variegation if



raised from seeds, and grasses such as Miscanthus that fail to set seeds in colder climates. Division is also a useful means of rejuvenating mature grasses that are congested and bare at the center

### DIVISION

Division of grasses can be a simple process and should succeed, provided that it is carried out at the correct time of the year. Grasses produce new growth buds, some of which are quite large, in summer, these he dormant until the following spring. In general, it is best to divide grasses just as the buds start into growth, usually in midspring. This is especially important for bamboos, if divided at other times of the year the success rate is generally poor because of the risk of rot or drought. Other grasses, if grown on light soils or in warm chmates, may be divided in autumn

### DIVISION OF SMALL GRASSES

For small, clump-forming grasses, cut back the foliage for easier handling, then lift the clump. Shake off loose soil from the roots, or wash the roots clean, to make it easier to separate them. Divide the clump into good-sized sections, as shown above. Trim any overlong or

damaged roots from each division If the clump is tightly packed or tough, as with Miscanthus, use a sharp knile or a spade to cut through the roots This will inflict less damage to the roots than pulling the rootstock apart

### DIVISION OF BAMBOOS

Bamboo roots are sensitive to drought, so choose a cool, overcast day for division to prevent drying out. It is also wise to wear heavy gloves, bamboo leaves contain silica and are very sharp

Some bamboos have long, thin rhizomes with shoots all along their length, these spread out to form a loose clump that can be invasive. Divide this type as shown below, taking strong, new rhizomes from the edge of the clump

Other bamboos have short, thick rhizomes, with shoots at the tips, that form a tight clump. (Continued on p.176.)

### DIVISION OF RHIZOMATOUS BAMBOOS



In spring, loosen the soil around a champ of I bamboo to expose the rhizomes, with their new buds, at the edge of the clump. Sever these from the parent plant, using primers



Cut the rhizomes into pieces, each with at Least one hild. Pour some fungicidal powder into a small dish and dip the cut surfaces into it see inset!



Pot each piece individually into a free-I draining soil mor, with the rhizome just below the surface of the mix and the shoots exposed. Firm in, label and water well

### DIVIDING LARGE GRASS CLUMPS



Look for an offset champ then the decision of set o



2 to home here have a the offset to the main clamp Lse loppers on an actock to sever them, then his the offset



3 Divide the offset into pieces rach with at least 1-4 buds from the rb mies to form near root balls. Replant at the same depth as bet re water in and tabel

### PROPAGATION FROM SINGLE BUDS



ONVIABLE A

Small pieces of rhizome that an broken off during division may be grown on, provided that each has a healthy growth bud (see right). Discard any with weak buds (left). Grow on an pois to a frost-free place or in a nursery bed for a year before planting.

(Continued from p 175) If possible, lift the entire clump. Using pruners or a large knife, divide the rhizomes into pieces, each with several growth buds Take care not to damage any fibrous roots. Cut the stems down to 12in (30cm) to reduce water loss. With a large tough clump of bamboo, it may be more practical to take off an offset clump at the edge of the plant (see below)

### DIV DING LARGE GRASS CLUMPS

Large clumps of tall grass can be divided using two back-to-back forks, as for other fibrous-rooted perennials (see p 148) or, if the rootstock is tough, with loppers, a mattock, or an ax. Established clumps of bamboos and other grasses that are too large to lift usually have offset clumps that can be separated, as shown above

Choose an offset clump and cut the stems down to 2ft (60cm) for easier handling. When digging out the offset clump and dividing it, be careful not to tiamage any of the growth buds at the base of the stems they are sometimes brittle and easily snapped off. Discard any woody sections, and trim damaged roots or rhizomes.

Any single-budded pieces (see above right) that become detached from the clump may be grown on but need more care and time to establish than usual

### GROWING ON DIVISIONS

Grass divisions may be replanted in the garden, lined out in a nursery bed, or potted, depending on their size and local conditions. If planting out, choose a sunny site with free-draining, moisture-retentive soil, very fertile soil encourages foliage at the expense of flowering

Small or tender divisions are easier to manage if potted, use a free-draining soil mix (see p 34). Keep the potted

divisions cool and moist and out of sun and drying winds until established. A closed cold frame is ideal, when signs of new growth appear, open the frame Most bamboos and grasses will be ready for planting out after a year.

### SOWING SEEDS

If grasses are allowed to seed in the garden, the resulting seedlings tend to crowd out established plants, and it is almost impossible to identify seedling grasses or distinguish desirable kinds from weeds. Gather well-developed healthy inflorescences just before their seedling are fully ripened to extract seeds for sowing (see below)

Grasses may be sown directly into outdoor beds, but the seedlings must be rigorously thinned to give each room to develop. It is better to plant containergrown seedlings (see p.152). Some grass seeds are large so can be space-sown Keep them at the required temperature (see A–Z of Ornamental Grasses, facing page). Most grass seeds germinate in a

week if sown fresh. Transplant seedlings one to a pot or cell, as soon as they are large enough to handle. Transfer pots of established seedlings to a frost-free place to grow on. Plant out in midspring.

### SOWING LAWNS

Lawns are popular in cool-temperate regions, but less so in areas of low summer rainfall, because they require regular irrigation. Lawn seed mixtures vary, depending on region and climate and what quality of lawn is required.

Modern breeding has produced improved selections of tough, perennial ryegrass that tolerate close mowing and produce a hard-wearing, fine turf, ideal for family gardens. Fine fescues, bents, and bluegrasses are more suitable for quality lawns where appearance is paramount. If extending a lawn under trees, choose a mixture that includes shade-tolerant species and cultivars.

In areas with dry summers, clover is sometimes added to the seed mixture because it remains green, while in hot regions, drought-tolerant grasses such as

### GATHERING GRASS SEEDS



GATHERING Cut stems there of Miscanthus) once the inflorescences have fluffed up fully (above right If cut too soon (above left) the inflorescence will contain no seeds

EXTRACTING Keep the grass stems in a cool, dry piace for a few days to allow the seeds to finish ripering. Strip off the seeds from each spine, they should come away casaly. Sow at once of store until spring. Sow 4-5 st ds at a 3in (8cm) pot or arthyduals, in cell packs, in free-draining sorliess seed.

Cynodon dactylon C transvaolensis, and Digitaria didactyla are used, although they may turn brown in winter

A lawn may be in use for decades so if creating a new one prepare the site thoroughly. Start well in advance of early autumn or spring sowing. First remove any roots, large stones, and weeds, then rototils or dig over and level the area incorporating well-rotted organic matter to a depth of 10in (25cm). Spot-treat any perennial weeds that appear in the next few months. In heavy, clay soils, it may be necessary to improve drainage with gravel or drainage pipes. In dry areas, install irrigation.

its, before sowing from the so I with a roller or by treading. Rake to remove small stones and turn is and tecreate a fine tilth. Sow in early autumn or spring, after rainfall or irrigation.

For large areas, it is convenient to use a spreader, but small lawns may be sown by hand. For even sowing, mark out the area into equally sized sections (see right). Weigh out a volume of seeds for one section, and place in a measuring container. You can then measure, rather than weigh out subsequent amounts of seeds. Mixing the seeds with an equal amount of sand and scattering them from a plastic pot is quick, easy, and ensures even coverage.

If the area is small, cover to protect it from birds and keep moist. Remove the cover as soon as a rimanities occurs In warm in est conditions seedling grass should be growing well by late

autumn or early summer

### **SOWING A LAWN**



I should be some some of capital to the section of the section of



2 mer of the series of the area from birds with plastic sheeting or netting in dry weather we eer the site regularly

### SOWING WITH A SPREADER



For large areas a spreader is useful. Some that the section is the act of and along the plant of the structure of the plant of the spreader has over a specific and push the spreader has over a



Once the grass is about 2m (5cm) that tist a lightweight mower with very sharp blades to cut it to a height of 1m (2.5cm)

### A-Z OF PERENNIAL GRASSES

Sow seeds of following generanonvariegated forms on year at a minimum temperature of 50°F (10°C) | Divide in spring | 1GRUSTIS ALUPBO RUS FORTALL GRASS CALAMAGROSTIS REED GRASS DACTYLIS DESCRIPTION OF THE PROPERTY 1 30 3/1 12 ( PESTUCA FESCUE GLYCERIA II. HOLEUS I we see flyn as MELICA MELICK Macy M Mount Assum omies the removers MOLINIA PENNISETUM FOUNTAIN GRASS PHALARIS PHRAGMITES GIANT REED PHYLLOSTACHYS (bamboo) Pot divisions with at least two growth buds, seep in a closed frame until new shoots appear. Pot on when pots fill with roots,

Peg down tipe flowerheads of Palpina var vivipara to obtain rooted plantlets (see p 150) 11.

SASA (bamboo)

SESLERIA

Sow seeds of following genera-(nonvariegated forms only at a minimum temperature of 59°F (15°C) & Divide in spring & ARENDINARIA (hamboo) As an Divisit Hake single noded cuttings from new stems respong place herromates correspondent arrays as for root cuttings (see p. 158), keep moist at 59°F (15°C) to root 11. BAMBUSA BAMBOO BOUTELOUA. CRIMONOBAMB(ISA (bamboo) Take thizome sections (see p 175). ( me HEM Distinct male and female plants fertilized seeds

rem tem reside vials e to a harther lac rhizome sections (see p 175). CORTADERIA PAMPAS GRASS. TUSSOCK GRASS Sow fertile seeds from female plants, less common self-fertile types often self-sow. Divide as for large grasses, cut me smalet preces grow on n p=45 a, 60 l + 1 t CIMBOPOGON DANTHONIA DENDROCALAMUS (bamboo) Sow seeds at 64 h B & H | lance sections of stem (culm), place them be rigorita. In spongment mess at "0 1 2) ( toot 11 ERAGROSTIS LOVE GRASS FARGESIA (bamboo) Take thizome sections (see p. 175). HANONECHEDA MACRA HELICTOTRICHON HIMALAYACALAMUS (bamboo) Sow seeds at 64°F (18°C) IMPERATA. MISCANTHUS

the a slane well uttless for sent pe non-lowering shoots in late summer (see p 154) II. PLEMILASTI'S (bamboo) Psetroosasa (bamboo) SACCHARPM (syn. Erlanthus) Sow at 70°F (21°C) Take single-node S OF CHILL IS ID Spring as her Visitor root at 64"1 (18 C. II. SEMIARUNDINARIA (bamboo) Take thizome sections (see p.175) SHIBATAEA (bamboo) Take thize me sessions wer 1 5 SORGHASTRUM. S IN A TOR & Removerance planders out p 150, produced on shoots from underground stems in autumn 11. STIM (syn. Achnatherum) Speak FEATHER, OR NEEDLE GRASS YUSHANIA (syn Singrundinaria) (bamboo)

For annual grass x we Annuals and Bienmals (pp 220-29

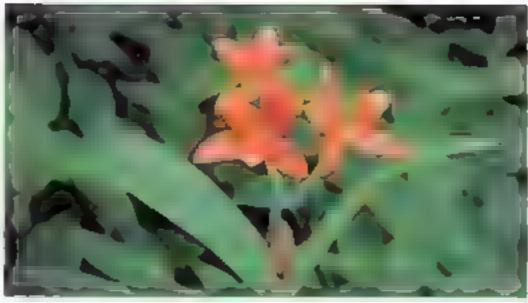
# ORCHIDS

All orchids belong to the huge family Orchidaceae, with some 835 genera, 25,000 species, and many thousands of hybrids. Many, with flowers of fabulous shape and speciacular color, are among the finest of cultivated ornamental plants. During their evolution, orchids adopted different modes of growth and adapted to their habitats by becoming epiphytic or terrestrial. These physical adaptations are significant both in terms of their cultural needs and in the methods used for propagation.

### **EPIPHYTIC ORCHIDS**

Most cultivated orchids are epiphytes and a few are lithophytes, that is, occurring on or among rocks. Epiphytic orchids grow on trees, but they are not parasitic. They use aerial roots to absorb moisture from the air and take nutrients from decayed leaf litter that collects in branch crotches and on the trunk. The aerial roots also act as anchorage, often adhering to the bark for part of their length before hanging freely in midair Epiphytes display one of two growth habits, sympodial or monopodial

In sympodial orchids, the terminal growth ends in a flower spike, or inflorescence. Increase in the plant's size arises from lateral buds, known as "eyes," on pseudobulbs, which are found at the base of previous growths. Orchids with a monopodial growth pattern have extended stems or rhizomes, and al



new growth arises from the growing tip
Flower spikes occur on the stem at the

The conditions in their native habitats enable epiphytes to survive with their roots exposed to the elements. Epiphytic orchids occur in warm, humid rainforests at low altitudes or at sea level, as well as in cooler, high-altitude rainforests. This indicates the range of temperatures needed for cultivation and propagation. Cool-growing orchids need minimum temperatures of 50–55°F (10–13°C); the intermediate-growing orchids, 57–66°F (14–19°C), and warm-growing orchids 68–75°F (20–24°C).

base of mature leaves

For most epiphytes, a mix made up of three parts fine granulated bark to one part perlite and one part charcoal serves for both potting and vegetative propagation (see also pp 33-4) Mony ciditivated orchids are tropical epipoytes such as this Cattleva taranuaca. In the wild, it grows on a tree and absorbs moisture from the air Decaying tent later of the branches provides outrients, and the warm that I can are allows the indicated without harm be exposed without harm

### TERRESTRIAL ORCHIDS

Ierrestrial, or ground-dwelling, orchids predominate in cooler climates where epiphytic orchids are not able to exist. There are also many tropical terrestrials, for example Hapenaria. Terrestrial orchids are mostly deciduous and have one of two principal growth habits. They are either rhizomatous or produce underground tubers, each supporting a leaf rosette and a central flowering stem. The plant is dormant in winter and remains so until spring.

Adopting the dormancy habit, along with possessing underground storage organs, confers greater cold tolerance than is seen in the epiphytes. Most so-called hardy orchids are terrestrials, and although some are hardy in many areas few can tolerate very damp winter conditions and so are more safely grown in a cold greenhouse or alpine house

Most terrestrials require a freedraining mix, which may contain soil, grit, peat, leaf mold, osmunda fiber, or fine bank

### SYMPODIAL ORCHIDS

Sympodial orchids include those, such as Cattleya, that have pseudobulbs (swollen, food- and water-storage organs), which bear leaves and flowers A dormant, leafless pseudobulb is known as a backbulb Backbulbs can be used for propagation, since removal from the rhizome usually activates dormant eyes. Not all sympodials have pseudobulbs, a few produce leafy growths instead, such as Paphiopedilum

Propagation of sympodial orchids with pseudobulbs is most usually by removal of single backbulbs or by division. Backbulbs take a few years to flower, while divisions of a large plant may bloom in the following season, provided that each division has at least four pseudobulbs. The basic techniques are similar for all sympodial epiphytes with pseudobulbs, but variations are made to accommodate differences in

### COMMERCIAL METHODS OF RAISING ORCHIDS

Meristem culture permits the commercial production from one orchid of thousands of identical offspring by culturing growth cells, taken from a dormant bud, in a laboratory (see below and p. 15)

Raising orchids from seeds also involves skilled laboratory work. In the wild, the tiny seeds rely on sugars that are produced by symbiotic microfungi to provide them with energy to germinate. In cultivation



ORCHID SEED One orchid can produce a militon tiny seeds. They are very vulnerable to airborne bacteria and so must be gathered and sown in completely sterile conditions.

the seeds can be germinated on agar-based media that contain all the necessary nutrients. Seeds must also be gathered and germinated under totally stende conditions to avoid their being killed by airborne bacteria. In flower, seedlings naturally vary, and the best are selected for meristem culture. It is possible for the gardener to grow orchids from seeds, but it requires special equipment and some degree of skills.



MERISTEM CULTURE Cells from the growth bud of an orthid pseudobulb are cultivated in sterile conditions on a special nutrient gel to produce large numbers of teny plantlets

### DIVIDING PSEUDOBULBS OF SYMPODIALS



In spring, an orenid there a Cymbidium, with eight or more pseudobuths may be divided into two. Knock the plant out of its container. Shake the excess mex from the roots



3 Remove any teatless backbalbs from the divided sections. Descard any that are old and surveiled. Plantp backbulbs may be potted separately (see below) to grow on

structure and habit. With some orchids such as in Odontoglossum, increasing by backbulbs is rarely successful because they seldom produce enough dormant eyes. In this case, it is possible to propagate from a leading pseudobulb (see p. 180). Other sympodials, as in Dendrobium, form adventitious growths—small plantlets that may be separated and potted (see p. 181).

DIVID:NG PSEUDOBULBS OF SYMPODIALS A well-grown plant produces one or more new pseudobulbs annually, each of which will live for several years. Each new pseudobulb grows from the base of the previous one, on a tough connecting rhizome. To flower in its first year, new growth depends on the young pseudobulb obtaining nutrients from the more mature pseudobulbs, even after forming its own roots and leaves. So, if plants are to flower in the season after division, each piece must have four or more plump, green pseudobulbs. Any shriveled brown pseudobulbs are dead and should be discarded

Division of most sympodial orchids follows a similar pattern to that shown above. Division is carried out in spring when the parent plant is being reported. Knock the plant out of its container and remove the oldest, leafless pseudobulbs.



2 Push the pseudobulbs apart slightly in the center and, with a sharp pruning hinfe, cut down through the woody rhizome that joins them. Pry the plant apart into two sections



4 from off any dead roots, using clean, sharp proners. Trun back longer healthy roots, but be sure to retain at least 6m (15cm) of living root to anchor each plant in its new per

to leave at least four on each division Separate the pseudobulbs by placing a clean, sharp pruning knife between them and pushing down vertically to cut through the rhizome

In most genera, the rhizome connecting the pseudobulbs is so short that it becomes visible only during this procedure, but it is essential not to slice through soft tissue at the base of the pseudobulb, which will render it useless To avoid this, push the pseudobulbs apart firmly with fingers and thumb before inserting the knife. Cut off the



5 Repot each divided section in a containe that is just a bitle larger than its root ball Hold the base of the pseudobalbs level with the run of the pot, then fill in with orchid back

dead roots, but leave some living roots to anchor each division in its pot. Pot each division with the pseudobulbs sitting on the surface of the mix so that new growth, which should appear within six weeks, does not rot away

Propagation from single backbulbs As a pseudobulb ages after flowering, it eventually drops its leaves but is still alive and has sufficient reserves to sustain further growth. Some orchids tose all their leaves at once; (continued on p.180)

### PROPAGATING SINGLE BACKBULBS



Pot up plump, healthy backbulbs (see inset) singly in 3m (8cm) pots of orchid moc 5m the backbulb on the surface of the moc to avoid rotting the dormant growth bads



New shoot grows from bust of buckbuth

Place the backbalb in a cool shaded position and keep moist. Within six weeks the bads should start into growth, and after 2-3 months the backball should have a new shoot

#### DIVIDING A LEADING PSEUDOBULB



In spring or dutumn, when it is not in fall growth or completely dormant knoch the plant (here a Barrageara) out of its container Carefully tease out the mix from the roots to reveal the leading pseudobalt

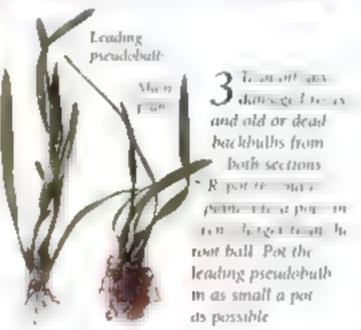
(continued from p 179) others shed one leaf at a time over two or three years. While still attached to the main plant its role is to support new growth and flowers. But if leafless backbulbs are separated from the parent plant while still green and plump, they may be used for propagation, provided that four pseudobulbs are left on the parent plant.

Sever single backbulbs from the parent plant with a clean, sharp pruning knife, taking care not to damage the softer tissue at its base. Where the backbulb is covered with basal leaf bracts, peel these away until a dormant bud, or "eye," is visible at the base (see right). Depending upon the type of orchid, there may be one or several. Cymbidium orchids will have several eyes, with the strongest ones at the base of the backbulb and weaker ones higher up.

Remove any dead roots from beneath the backbulb, but leave about 2in (5cm) of good roots to anchor it in its pot Pot it (see p 179) in orchid mix and grow on in a closed case. Keep the case at a temperature to suit the individual orchid, according to whether it is cool, intermediate, or warm-growing (see p 178 and A–Z of Epiphytic Orchids, pp 181 and 183)

A new green shoot should appear within six weeks, and, after a further four weeks or so, new roots should emerge. At this stage, remove the plant

Place the root ball on its side I se a clean sharp scalpel or kinfe to cut down through the rhizome between the leading pseudohulb and the backbulbs. Carefully pull tree the teaching pseudobulb, if necessary, cut through the course



from the case and place it in the greenhouse or indoor growing area in good light. After a further six months the plant can be "dropped on," that is, potted into a larger container, without disturbing the mass of mix or the new growing roots. Pot again after one year and, from then on, as necessary until the plant is mature

At some stage during this time, the original pseudobulb will become exhausted. It will shrivel and die and can then be removed from the young growing plant and discarded. The new plant should reach flowering size after approximately four years

Sometimes, two dormant buds will grow on at the same time from the same pseudobulb. Such plants are "double-leadered." In a few years, each leader will form an independent plant, so that there are two within one pot. When it becomes possible to leave four or more pseudobulbs on each piece, they can be divided. Plants reduced to less than four pseudobulbs are unlikely to bloom again until sufficient strength has been built up, which may take several years.

Dividing A LEADING PSEUDOBULB
With some groups of orchids, notably
the Odontoglossum group, propagation
by backbulbs is seldom successful. An
alternative, although risky, method of
propagation is by removal of the leading

pseudobulb. It must be attempted only with strong, healthy plants with leaves on all, or most, of its pseudobulbs

The Odontoglossum group includes all species of the genus Odontoglossum as well as closely related genera, hybrids (including intergeneric hybrids), and any cultivars derived from them, for example x Odontocidium, which is an intergeneric hybrid between Odontoglossum and Oncidium. All plants with Odontoglossum species in their parentage may be increased in the same way

Propagate from leading pseudobulbs in spring or autumn, when the plant is neither in full growth nor dormant, and the leading pseudobulb has new shoots about 6in (15cm) tall. Knock the plant out of its pot and separate the leading pseudobulb from the rest of the plant by cutting through the connecting rhizome. Tease apart the roots gently If necessary, cut through them, but take care not to damage the pseudobulbs.

Pot the leading pseudobulb with its own roots into as small a pot as will comfortably hold it. Replant the rest of the plant into a pot a little larger than the root ball. New growth should appear from the base of the second pseudobulb and go on to flower when mature.

Propagation of the Cattleya Group The Cattleya group are epiphytic,

sympodial orchids. The term applies to all species of Cattleya as well as other closely related genera and intergeneric hybrids between them, such as x Lachocattleya. All orchids with Cattleya species in their parentage are propagated in the same way. The group produces short rhizomes and erect, stout to slender pseudobulbs, each with one or two semi-rigid leaves.

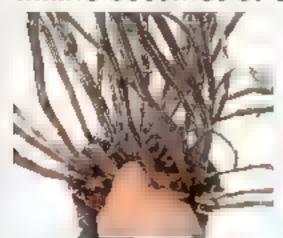
They can be increased by separation of backbulbs in the usual way and can also be divided into equal parts of four or more pseudobulbs, where each has a

#### DORMANT EYES



When dividing pseudobulbs and backbulbs look for dormant "eves" at the base (here of a Cattleya). These should be fat and green; if shriveled or brown, they are dead. There should be at least one healthy eve on each pseudobulb or backbulb to be propagated.

#### TAKING CUTTINGS OF DENDROBIUM



7 Remove a 13m (25cm) long I se con of a healthy cane Cut with a sharp knufe just above a leaf node or at the base of the case

Cut midway between mades

Cut between the leaf nodes of L the cane dividing it into pieces about Im (Hem) long. Each cutting strenkl have at least one node



Till a seed tray with moist sphagnum moss. Lay the cidlings on the moss, cover, and keep in a hunud, warm place



A The cuttings should root in a T tew weeks, producing plantlets Once they are large enough to handle, pot them individually

new growth (see p. 179) Sometimes, however, the older pseudobulbs or backbulbs lack new growth. If so, they can be started into growth by cutting through the rhizome between the pseudobulbs, without lifting them, in early autumn Leave the divisions in place until the following spring. Separate and repot them when new growth appears on each division, but before new roots grow out from the bases of the new growth, to flower 2-3 years later

ORCHIOS WITH CANELIKE PSEUDOBULBS At first glance, some sympodials, notably

Dendrobum, seem to be monopodial, because their leaves grow at the ends of long seldom-branching stems. In fact the "stems" are canelike pseudobulbs, they may have leaves growing from nodes on the cane or from the cane's tip-Howers develop from nodes along the canes usually in spring Dendrobrum and Thunia with canes will produce new growth from dormant buds at the nodes so can be increased from "stem" cuttings (see above), which flower in 2-3 years

Sometimes, Dendrobium produce adventitious growths, or small plantlets, from nodes on the cane. These, too, can be used for propagation (see right) Most plantlets flower in 2-3 years.

DIVIDING ORCHIDS WITHOUT PSEUDOBULBS Some sympodials, such as Paphiopedilum and Phragmipedium, do not develop pseudobulbs. Both are challenging to propagate; they have no backbulbs and do not respond well to division. Some species are also notoriously reluctant to flower before they produce multiple shoots, usually in 4-5 years

These on hids can be divided, when they have at least four growths, by cutting through the thick rhizomes before growth begins in late winter or early spring, in much the same way as dividing pseudobulbs (see p.179) However, it is advisable to attempt this only with mature, well-developed plants, so that the multiple growths needed for flowering remain on the parent plant

#### PROPAGATING FROM ADVENTITIOUS GROWTHS



1 Choose a plantlet with strong healths roots I have a Dendrobium, and sever it from the parent stem with a clean, sharp bulk



? Pot the plantlet in a 3m (8cm) pot of fine are orchid mix. Make ware that the rooty (see inser) sit just below the surface

A-Z OF EPIPHYTIC ORCHIDS And Cool growing sympodial divide plant or remove backbulbs (see p 179) 111 AFRIDES Cools to intermediate growing monopodial, as for Vanda (see p.183) [1] ANIAMECE M. Propagation not recommended. AVAITON CRADITION TYTH ORGIND Cool growing sympodial divide plant or remove backbulbs (see p 179) in spring 1 \* Angricolaste Cool- to intermediategrowing sympodial; as for Auguloa ARACHNIS SCORPION ORCHID. Warms or intermediate-growing monopodial, take stem sections as for Vanda (see p. 183) 11 Ascocentre w. Intermediate-growing monopodial, as for Vanda (see p. 183) [1] BARKERIA Cool-growing sympodial, divide as for Paphiopedilum (see left) in spring 🚻 BRASSAVORA Intermediate-growing sympodial, divide stemlike pseudobulbs of large plants in spring 11 Brassia Cool growing sympodial divide plant or remove backbulbs (see p. 179) 1. x Brassocattlesa Intermediate-growing sympodial remove single backbulhs (see p 179) in spring 1 x Brassolaffior artiffa. Intermediate growing sympodial, remove single back bulbs (see p 179) in spring 1. BULBURHILLIM Cool-, intermediate- or warm growing sympodial divide backbulbs

(see p 179) in spring II CAPTLESA Intermediate-growing sympodial, divide or remove single backbulb (p 179) 1 COELOGINE Cool- or intermediate-growing sympodial, divide plant or remove back bulbs (see p 179) in spring 1 COMBIDITY Cool growing sympodial, divide plant or remove single backbulbs (p 179) 1 DENDRORDM Cools to intermediate-growing sympodial, take stem cuttings in spring or remove plantlets (see above) 1 DENDROCHAEM GOLDEN CHAIN ORCHID. Cool. growing sympodial; divide plant or remove single backbulbs (see p. 179) in spring 1. DRACULA Propagation not recommended. ENCYCLIA Cool growing sympodial, divide plant or remove single backbushs (see p 179). in spring EPIDENDRUM Cool- or intermediate-growing sympodial, divide as for Puphiopedilum (see left) in spring I. A lew are terrestrial LARLIA Cool- or intermediate growing sympodial, occasionally divide backbulbs (see p. 179) in spring 🚻 x LAELIOCATTLETA Cool-growing sympodial divide plant or remove backbulbs (see p 179) in spring 1 LEMBOGLOSSUM Cool-growing sympodial. divide backbulbs (see p.179) in spring [

(Continued on p. 183)

# MONOPODIAL ORCHIDS

Instead of pseudobulbs, these orchids have an upward-growing stem or rhizome with new leaves produced at intervals from the growing tip. Some, for instance Phalaenopsis, have a short rhizome and as new leaves develop at the top, older leaves below are shed, so that at any one time the plant bears 3-6 leaves. Orchids with this habit are self-regulating in size and never become unduly tall. Other monopodials, such as vandas, produce a much longer rhizome with many leaves appearing in pairs in succession from the apex, while the rhizome grows continually taller. With either growth habit, normal division is impossible

While many monopodials do not increase as readily as sympodials, they do have a natural ability to reproduce if the growing tip, where the new leaves form, becomes rotten or damaged. If this occurs, a plant may produce new growth from a point lower down on the stem. This ability may be exploited for propagation. Only Phalaenopsis orchids produce new plantlets on flowered stems (see below), while others produce plantlets at various points along the rhizome or near the base

#### **TAKING STEM SECTIONS**

Monopodial orcluds, such as in Vanda, that produce a long, upward-growing thizome may be propagated when the

parent plant reaches a certain size and stage in its development. As the plant grows, new leaves are made at the tipand old ones are shed from the base. Eventually, the lower portion of the stem becomes bare and leafless, with aerial roots emerging from the axis of old leaf bases. At this stage, the top part of the plant may be removed, together with its aerial roots, to encourage the lower leafless portion to produce new growth (see facing page). This is also a good way of managing plants that have become too tall and top-heavy, but it does carry some risk to the parent plant so should be done only when absolutely necessary,

in spring, at the start of the growing season, cut through the rhizome with a sharp knife and repot the top portion of the plant. Place in humid shade with a nighttime minimum of 61-66°F (16-19°C); mist-spray regularly with nonalkaline water for a few weeks to avoid the sections drying out

Wrap the lower stem in damp moss to encourage one or more new roots and shoots to form. Cover the moss with clear plastic and tie in place, Keep the moss damp. New growth should appear in a few weeks, at which point the plastic and moss should be removed

Alternatively, leave the leafless lower portion of the plant in its container and place in a closed case at the appropriate temperature (see p 178 and A-Z of Epiphytic Orchids, pp. 181 and 183) Within a few weeks, a new plant should begin to grow from a node near the stem base. After 6-12 months, when the new plant has at least two pairs of leaves and its own roots, it can be removed from

the old stem and potted

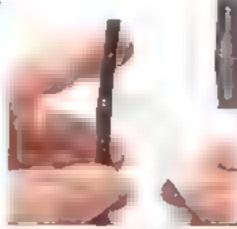
#### PROPAGATING PHALAENOPSIS FROM KEIKIS



1 Wash your hands and use ■ a sterilized scalpel Select a ical node, then make a vertical rat drivir the center of the bract that covers the node. Do new cut into the bud becorate



O Carry Sold of Transactors - precession output in a the two halves of the bract to expose the eye. Do not leave ans succe Ren with its to mill be the ever stem.



1 se a sterilized plant I ibel er a spatula to smeat a little heiki paste (giowth) harmone) over each prepared eve (see inset) and the exposed tissue around it

4 After 6-8 weeks
the treated nodes st oald produce tins plantlets. Lay the SICULTACTUSE SOON small pots of orchidmox Peg each plantlet singly into a pot ded keep most to October if to not ete the m.v.

PLANTLETS



☐ Vice 12–18 o artis, where the plantfets are at least im (8cm) tall they may be detached from the parent plant Cut the parent stem next to the plantlet and citt back to its base The new plant shead



Function arises from leaf node

Some Phalaenopsis, particularly P hieddemanmana, occasionally produce planticts from the old flowered stems. Separate the plantlet from the parent by severing the stem Lin-(2.5cm) below the plantlet Prepare a 3in (8em) pot of orchid mix, then sit the plantiet on the surface. Anchorthe aerial wots to the surface with wire staples.



PROPAGATING FROM PLANTLETS

Some monopodial orchids reproduce freely and naturally by producing new plantlets at various points along the thizome or near the stem base. These can be left on the plant until they are established and have their own leaves and roots. At this stage, the plantlets can be removed and potted separately without any risk to the parent (see left) most will flower in 1-2 years.

Phalacnopsis species have short, upward-growing rhizomes, each with 3-6 oval, fleshy leaves. They rarely produce new growths from their base naturally but may do so if the center of the plant becomes damaged or rotten The flower spikes, which appear from the base of the leaf, are unusual in that their stems have nodes on the lower portions, each with a tiny potential growth eye beneath a covering bract.

When the first flowering from the stem up has finished and has been cut off, the lower nodes may be sumulated to produce a second flowering stem

#### TAKING A STEM SECTION OF VANDA GROUP ORCHIDS



I vanda and allied orchids have a single stem when this becomes top-heavy, the plant them various or var susyis) may be cut may so a us to encourage new growth from the lower stem.

This can be useful in lengthening the flowering period by several weeks or even months. It sometimes occurs naturally to such an extent that stems need to be removed altogether if the plant is not to flower itself to death

Nodes on the lower flowering stem can be encouraged to produce plantlets or keikis, instead of flowers, by treating the nodes with keiki paste (available from some orchid specialists). This compound contains rooting hormones and growth-promoting vitamins. However, it can be quite difficult to maintain the sterile conditions that are essential for success.

As soon as the first blooms fade remove the top, flowered portion of the stem. Select a node and remove the bract carefully as shown (see left). Coat the bud and the tissue immediately around it sparingly with keiki paste. Treat 3-4 nodes per stem and only two stems per plant. New plantlets should develop within 6-8 weeks. Leave them on the stem until new leaves and roots have grown. Peg down each plantlet onto a small pot of mix and allow the plantlet to root directly into the new pot before detaching it from the parent stem.



2 Remove one or two portions of the sten cutting straight across the stem between leaf nodes with primers. Make sun, that the section has some healthy derial roots.



Mose actual motito tead over not

Plastic coated steel stake supports stem until it roots

A Pot the top
stem so to r
or orchal nux 5.1
the base of the
stem just in the
mix and support
it with a struck
stake until it roots
to not burs the
aerial mots
because they will
be prone to not



3 Wrap the leafless lower stem in a Am t1cm layer of moist sphagnum moss to encourage tew shoots. Secure the moss in place with twine then wrap in clear plastic. Keep the moss moist



Large stem secret at an and flower again

5 keep the stem to seem a the shade as a minimum of about 64% (18%). Spray it frequently to avoid dehydrat on antil the new mors establish.

#### A-Z OF EPIPHYTIC ORCHOS

(Continued from p.181.)

Ortaste Cool-growing, sympodial epiphytic or terrestrials. Divide plant or remove single backbulbs (see p.179) in spring [

M + Propagation not

feethholes

Vit rowa Cool- or intermediate growing sympodial remove single backbulbs was p 179) in spring 11

Microstopsis Passy one into Cool growing sympodial divide when large enough (see p 179) in spring [1].

as for Odontoglossium

as for Odontoglossum

Obsistostossem Cool-growing sympodial divide leading pseudobulb (see p. 180) [1] x Oboxiosia. Cool-growing sympodial: as for Odontoglossum

Overbreat Cool- or intermediate-growing sympodial, divide those with pseudobulbs or remove single backbulbs (see p. 179) in

Spring & Divide others when large enough & Paris, a content Street oreas. Consort intermediate-growing sympodial epiphytes or terestrais, divide by cutting through mizomes (see p. 181) 111

Phase surse Mont occup. Warm growing monopodial, remove rooted plantlets 1 or propagate keilos 111 any time (see p. 182). Phase survey of Cool or intermediate growing sympodial, divide by cutting through thizomes (see p. 181) in spring 111. Rossioccost of Propagation not recommended.

NANDA Intermediate to warm-growing monopodial: stem sections (see above) 111. x VETESTEREARA Cool-growing sympodial as for Odontoglossian

r Wilsonard Cool-growing sympodial, as for Odontoglossion

# TERRESTRIAL ORCHIDS

Commercial techniques for propagating hardy terrestrial orchids from seeds have produced an increasing range of available species and, once acquired, many are easy to propagate vegetatively ferrestrials are either rhizomatous (with rhizomes and, often, pseudobulbs that are similar to those of epiphytic sympodial orchids) or tuberous (producing a leaf rosette from a bud at the top of an underground tuber). The propagation method depends on the growth habit

A suitable mix may be made of equal parts soil, coarse sand, mixed pear and leaf mold, and fine bank, with a little bonemeal added

DIVIDING RHIZOMATOUS TERRESTRIALS

Most rhizomatous terrestrials are propagated in spring, just before growth begins. All divisions need food reserves if they are to establish as a new plant, so terrestrials are divided into pieces with a leading shoot and 2–3 pseudobulbs, on much the same principle as sympodial epiphytes (see p. 179). Terrestrial orchids often grow with their pseudobulbs

partially buried in the soil when replanting, set the pseudobulbs at the same depth as before. The divisions may be planted out in similar conditions to the parent plant or potted in pans and grown on in the greenhouse

Rhizomatous orchids that have no pseudobulbs may be divided into sections, each with 2–3 years of growth behind the leading shoot. These annual growths can be counted by the joints on the rhizome. Cypripedium do well if divided toward the end of the growing season, when their food reserves are distributed evenly through the rhizome. There is less risk of damaging any new growth, and the plants reestablish well before the onset of dormancy.

Most rhizomatous species regularly produce side growths from the main rhizome and provide plentiful material for propagation. A few branch rarely producing a single, continuously clongating growth, which makes normal division difficult. When these rhizomes show four or more annual growth joints, they can be induced to shoot from the dormant buds by cutting only halfway through the rhizome early in the

growing season. Do not cut through the rhizome completely, the aim is simply to reduce the dominance of the growing tip and induce formation of sideshoots. Leave each division of at least two growths in place until the beginning of the next growing season. If successful, active buds should begin to shoot in the spring. Lift the plant, separate the sections, and pot individually. Grow on in the same conditions as the parent.

#### PROPAGATING PLEIONES

Members of the genus Pletone may be epiphytic, lithophytic, or terrestrial They form tight clumps of single, small pseudobulbs that are in fact separate plants, rather than a succession of differently aged pseudobulbs on a connecting rhizome. The pseudobulbs flower in spring, then die back over the summer while a new pseudobulb forms ready to flower in the following spring. Only occasionally do pseudobulbs persist for a second winter to product new shoots in spring.

Clumps of Pictone may be lifted and divided in autumn (see below). The pseudobulbs usually fall apart naturally,

#### DIVIDING CLUMPS OF TERRESTRIAL PSEUDOBULBS



A Some terrestrial orchids, such as these Pleione formosana, form tightly packed champs when matare. These can be lifted and divided in the autumn, while the pseudobaths are dormant, to provide new plants.

2 last the domest projected bulbs as in parts as in a contact to a con

growth.



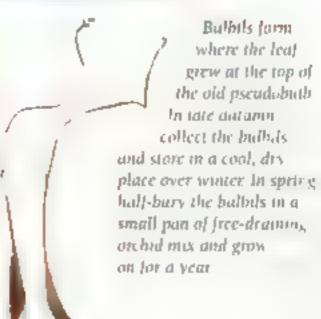


Clean off any dead matter, and remove only loose papers tunies from the stable pseudobutbs. Remove dead roots using a clean sharp kinder but to be a more and done of the low outer course the low outer course see use



4 Prepare 5-bin (13-15cm) pans of a free die many scotless potting mix. Space five pseudobials in one mix. Cover the roots with mix so that the growing "eyes" at the base an just above the surface. Water and label.

#### PLEIONE BULBILS



#### DIVIDING TERRESTRIAL ORCHIDS WITH IT BERS



Lift the plant (here a Dactylorhiza) at any time for in early automit to early spring. Gently wash off the soil to reveal the tubers. Cut the underground stembetween the old and the new tuber with a sharp kin.

2 Replant the parent and water well Fluid out the new tubers at the same depth as they were before, spacing them about bin (15cm) apart. Water and label

if they do not, gently push them apart until they separate. A plant may also produce bulbils (see box, facing page) at the point from which the old leaf was shed. The bulbils may be detached and used to increase stock.

#### PROPAGATING TUBEROUS ORCHIDS

The growth of tuberous orchids is similar to that of other tuberous plants and, like them, they vary in their ability to produce new tubers. Some, like Ophrys, rarely do so, while Dactyforhiza may form substantial colonies of offsets. Where new tubers are formed naturally clumps may be lifted and divided at any time during dormancy (see above). Many growers prefer to do this in early autumn to avoid damaging young roots which begin growth early in the year. After division, plant out the parent plant and the offsets where they are to flower.

Orchids such as Ophrys and Orchis that are reluctant to produce new tubers usually forming only one tuber a year to replace the old, can be coaxed to do

So by one of two forms of division

Summer" propagation is used just as
the flowers begin to fade, from early
spring onward, depending on the
species. Lift a plant from the soil and
detach the new tuber from the rosette,
cutting the underground stem, or stolon
that connects them just above the new
tuber's bud. The new tuber will be
plump and firm, as distinct from the
old brown and shriveled one

Repot the rosette and old tuber, with most of its root system intact. Pot the new tuber separately, treat it as if it is dormant and keep cool and dry. The old shoot (with its flower spike removed to prevent energy being expended on seed production) is kept in growth to allow more new tubers to be produced before dormancy.

Winter" propagation utilizes the unflowered rosette as it reaches full leaf development. By this stage, a new tuber should have begun to form below the rosette. Remove the rosette and new tuber together by cutting through the

bottom of the stem that arises from
the old tuber. Take care to leave a small
portion of stem with one or two roots
still attached to the original tuber.
The roseite should flower normally and
sustain the growth of the new tuber. The
old tuber will then develop one or more
growths from dormant axillary buds
on its stem, which will in turn produce
their own tubers. This operation can be
performed without removing the plant
from the soil or its container since
the two new plants formed are left to
complete their growth naturally

#### STEM CUTTINGS OF TERRESTRIALS

A few terrestrials, such as Ludisia discolor, have fleshy, segmented stems that root from the nodes as they touch the ground. This ability makes them easy to increase by stem cuttings (see below). Ludisia is subtropical in origin so, after the cuttings callus, pot in terrestrial orchid mix and grow on in a shaded closed case with high humidity and bottom heat of 68°F (20°C).

# LUDISIA STEM CUTTING The stems of the tern strad rewer orotad. I us, sia discolor) readily produce adventitions roots. Take 3-5m c8-13cm) stem tip cuttings, cutting below a mode and leave in a coel dry place for 48 h mrs to

#### A-Z OF TERRESTRIAL ORCHIDS

Brandle Mostly cool growing (B) strtata is hardy in Zones 5-8). and rhizomatous, divide inspring as for Pleione (see facing page) 1. Flowers in lirst year CALANTAE Mostly warms or cool growing terrestrials (C. discolor is hardy in Zones 7-9) and rhizomatous, divide just before growth begins in spring as for symposial epiphytes (see p 179) civisions must have a leading shoot and at least two pseudobulbs 11 Flowers in first year CYPRIPEDIUM LADYS SEPPER

ORCHID Rh zomatous, divide

The thes into sections in spring or autorin (see facing page) 11. Flowers in 1 a years Generally bardy in Zones 3-7 DACTITORREA MARSH ORCHUS SPOTTED ORCHID Tuberous divide when dormant soci above) 1. Flowers in 1-3 years Some hardy in Zones 5-8 EPPING DIS FILLLEBORGST Kn is matous, divide rhizomes (see facing page) when dormant in early spring 1. Some hardy in Zones 4-8 Flowers in first year GOUDYERA TEWEL ORCHID MOSTLY cool growing thizomatous Jivide in spring as for Ludisia

keep shaded, cool, and hunnd until established 111. Stem cultings as for Endisia L Flowers in 1-3 years. HISRNIKIA Warm growing. tuberous, divide in autumn or spring as for Dactylorhiga 11 Flowers in 3-4 years LUDISIA JUWEL ORCHID WARIN growing, librous rooted take stem cuttings (see above) 1 Flowers in 1-3 years Origins Tuberous, slow to " type use summer" and winter" propagation 111. Some hardy in Zones 7-9 Flowers in 1-4 years

Orems Taberous, slew to I we is summer and A DET PLY agation # Flowers in 3-4 years. Some hardy in Zones 5-7 PLERONE Rhizomatous, epiphyli, or terrestrial, divide pseudobulbs (see facing page) to flower the next year & Propagate from bulbils to flower in 3-5 years 11 Hardy in Zones 9-10 SERAPIAS Tuberous, spreads by stolons that produce new tubers at their tips - detach and replant new tubers in spring \$1. Flowers in first year. Hardy m Zones 8-9

carlas before porting

# A-Z OF PERENNIALS

# ACANTHUS BEAR'S BREECHES

DIVISION in spring or in autumn 1
Seeds in spring 11
CUTTINGS from mid- to late autumn 1

All Acanthus may be divided, especially variegated forms. They increase naturally from roots left in the soil so all except variegated plants are easy to propagate from root cuttings. Species can be raised from seeds. Use deep pots for seedlings and cuttings, Acanthus dislike root disturbance

#### DIVISION

Cut clumps into 2-4 pieces (see p 148)
Autumn division in areas with cold, wet
winters is not advisable. Plants divided
in autumn may flower the next year
spring-divided plants in two years

#### SEEDS

Sow the seeds (see p 151) at 59°F (15°C). Pot seedlings of line out in a nursery bed to flower in three years. Protect new plants from severe cold—in the first winter.

#### CUTTINGS

fake 2-3in (5-8cm)
root cuttings from
mature, healthy plants
(see p 158) Cuttings
flower in two years

Ropt NING SEEDHEADS
The tall flower spike (here of Acanthus spinosus) ripens from the base, each flower producing large shony black seeds

# ACHILLEA YARROW



Ach dea Tavgetes Division in spring ‡
SEEDS in addition of in spring ‡
GOTTINGS in spring or
in early an unit ‡

Both border and alpine forms of this genus are propagated in similar ways. They may be divided in the usual

way (see p.148) to flower in their first season or into single bud divisions (see p.150) for more plants. It may be possible to take self-rooted cuttings (see p.166) from alpines without lifting the parent. Sow seeds (see p.152) at 59°f (15°C), seedlings often flower in the first year. Take semi-ripe cuttings (see p.154) in early autumn or basal stem cuttings (see p.156) in spring from alpines and border perennials for flowers in a year.

# ACHIMENES HOT-WATER PLANT, CUPID'S BOWER

Division in autumn or in early sping 1
SEEDS in early spring 11

This tender genus has been extensively hybridized, many cultivars are grown. The plants are dormant in winter surviving as scaly rhizomes. The rhizomes (small, nodular swellings commonly called tubercles) increase in number naturally and can be gathered while the plant is dormant in autumn or winter (or when dividing the plant in spring) and used for propagation (see being)

To increase the yield of new plants, cut the tubercles in half before potting Plants flower in the same year

All species can be grown from seeds to flower in two years. Sowing seeds of cultivars or of plants that have been deliberately hybridized (see p 21) can result in interesting color variations. Sow on moss as for alpines (see p 165, at 64°F (18°C) in spring as the daylight hours are lengthening, short days induce dormance.

#### PROPAGATING ACHIMENES PLANTS FROM TUBERCLES



In the autumn after the foliage has died down, remove the dormant plant from its for or lift at from the bonder. Tease apor the roots and detach the tubercles from the ward roots.



3 in spring, prepare a 5m (13cm) pot with soulless potting mix. Lay about five tubercles in the surface. Cover with 2- in (5mm-1cm of vermiculite, label, and water well with tepid water Keep at about 50°F (15°C).



2 Descard the parent plant. Half fell a seed tray with moist pear. Scatter the tobercles events over the surface. Cover with Zin (Lent) of pear Label and store of a cool, dry place.



4 Water sparingly until shoots appear tomary about three weeks later. After 8-10 weeks the plantlets there of A erecta) should be viseveral pairs of leaves (see inset) and, after 12 weeks (above), may be period singly, if desired

# AETHIONEMA STONE CRESS

SEEDS in autumn or in early spring I Cuttings from late spring to early summer 11

The woody-based perennials in this genus (syn. Eunomia) tend to be rather short-bived, but most stone cresses come readily from seeds. Special forms and cultivars must be increased from cuttings

#### SEEDS

Some stone cresses, such as Aethionema grandiflorum and A. saxatile and their cultivars, will self-sow in the garden

especially when grown on raised beds Sow seeds (see p. 164) in autumn in a cold frame (of hardy types only in cold climates) or in spring at 50°F (10°C) Plants will flower within two years

#### CUTTINGS

Take softwood stem-tip cuttings, 1.4-2in (3-5cm) long (see p.166). Put in bright but indirect light, if too shaded, new shoots will become drawn. Pot singly once rooted, plant into final positions in the late summer or following spring.

# **AGAPANTHUS**

AFRICAN BLUE LILY



Agapanchus Bhie Giant

Species and cultivars in this genus may all be divided, especially those with variegated foliage. They are set back by frequent root disturbance, and older

plants reestablish slowly from division, three or tour year-old plants are an ideal age. Gathered seeds may not come true to type but can yield some interesting variations

#### DIVISION

Lift clumps and divide into 2-4 pieces using back-to-back forks (see p.148). Trum off any damaged roots. Substantial divisions should flower in the same year. Plants may be divided into single crowns to grow on in nursery beds or pots. Protect from severe cold in the first.

winter, if needed, and plant out in spring. In warm climates, plants may flower in 12 months, but most take 2–3 years

#### SEEDS

Seeds sown at 61°F (16°C) (see p 151) should germinate within three weeks. Grow on established seedlings in a cold frame and, if necessary, protect from cold, in spring, transfer to a nursery bed. The new plants should flower in the third year

GATHERING AGAPANTHUS SEEDS Cut flowerheads "in the green" when the sceapods are swollen but before they split open. Keep in a box of a warm, dry place with the seeds have been released



DIVIDING AGAPANTHUS

After dividing into sections, carefully trim off any old stems and damaged root tissue using a clean, sharp kinfe to cut straight across cach root. Dust the wounds with fungicide, such as sufur dust to guard against rot (see inset)

# ALCHEMILLA LADY'S MANTLE



Mehrmalia

DIMSION in spring | SEEDS in autumn or spring ||}

These perennials prefer full sun and most readily self-sow Most are hardy in much of North America, a few from southern Africa are less hardy

The fibrous-rooted clumps of any species or cultivar are easily divided (see p 148). Pull them apart and replant, or divide into single crowns with strong roots and pot them or line them out in nursery beds, the new plants should flower in the same year.

If raising the hardier species from seeds, the best results are obtained from an autumn sowing (see p 152), followed by exposure to winter cold Spring-sown seeds of less hardy plants kept at 60°F (15.5°C) will germinate within three weeks and may flower the same season



SEEDLINGS OF ALPINE LADY'S MANTEL

Lady's mantle there A alpina) often self sows in
the garden. Lift the seedlings carefully, as soon as
they are large enough to bundle, and transpiant

#### OTHER PERENNIALS

ABELMOSCHUS Sow seeds (see p.151) in spring at 60°F (15.5°C) [

ACASSA Divide in early spring or aut in the (see p. 167). It Sow seeds (p. 164) in gritty soil mux in autumn, in a cold frame II. Take stem-tip cuttings (p. 160) or self-rooted cuttings or runners (p. 148) in late spring I. ACASSHOUNDON Seeds (see p. 164) when ripe or user-ly spring; put in clocke or cold frame seeds have low viability III. Take senti-ripe cuttings (p. 166) in fate summer, remove lower spring leaves with scalpel, cuttings for easily III. Use very gritty soil mix, shelter in a cold frame, do not overwater.

Activitia Division (see p 148) in spring may be possible \$1. Sow seeds fresh (p.151) in autumn, put in clocke or cold frame \$1. Do not overwater.

Acontrast Divide (see p. 148) in early spring 1. Sow seeds (p 151) in autumn, put in cold frame or clocke germination may be slow 11. ACTAEA Divide rhizomes (see p.149) in spring 4. Sow seeds (p.151) outdoors in autumn germination may be slow 14 As On de after flowering days large cuts with fungicide (see p 148) 44. Seeds (p. 151) when tipe in gritty soil mix, put in cloche or cold frame, old seeds germinate errancally # Apachysanthus Sow tipe seeds (see p. 151) at 70°F (21°C), short viability 11 Softwood cuttings (p.154) any time [ AGASTACHE (SAID BRITTONASTREM) SOW seeds (see p 151) in spring at 60°F (15.5°C) å. Take semi-ripe cuttings (p. 154) in summer or autumn [ AGLAONEMA Divide in spring (see p. 148) 11 Sow ripe seeds (p. 151) at 70°F (21°C) [

Appeal Divide (see p. 148) or detach rooted plantlets in spring or in early autumn § 50% seeds (p. 151) in spring at 50% (10%) § Appeals to 50% (15.5%) § Appeals to 50% (15.5%) § Appeals to 50% (15.5%) §

ALOUASIA Divide in spring (see p. 149) 4, 50% seeds (p. 151) in spring at 77°F (25°C) 4. ALONSON As for Diascia (see p. 194) 4. ALEINO As for Alocasia (see above), but sow seeds when ripe

STREAM PICE Divide in early autonated spring (p.148) 4. Senti-ripe stem-tip cuttings (p.154) in early automn, softwood cuttings of overwintered plants in early spring 44. Arvssem. Sow seeds (see p.151) in autumn or early spring 4. Senti-ripe cuttings (p.166) at late summer, use rooting compound and gritty soil max 4.

ANACICIUS Sow seeds (see p. 151) in spring at 60°F (15.5°C) 1. Take basal stem cuttings p. 156) in spring 11.

YNAGALUS Detach self-rootec lavers (see p 24) at any time, best in summer 1. Sow seeds (see p [51] in spring at 50°F (.0°C) 1. ANAPHALIS Divide in spring (see p 148) 4. Sow seeds (see p 151) in spring at 50°F (.0°C) 1. Take basal stem cuttings (p. 156) in spring 1 ANCHUSA Divide into single crowns in spring (see p. 148) 1. Seeds in spring (p /51) at 50°F (10°C) | Take root cuttings of custivars (p.158) in autumn 11 Root cuttings (p 167) in late winter, or rosette cuttings (p.166) each with a piece of stem in late summer, of A. cespitosa 111

ACONITUM NAPELLES SEEDHEADS

# ANDROSACE ROCK JASMINE



A de seu

DIVISION in early summer 11
SEEDS in autumn or when ripe 11
CUTTINGS from early to midsummer 111

Perennial alpines in this genus (syn. Douglasia) rot if too wet, especially if cold. Dense cushion

types are best raised from seeds; larger, mat-forming types flower more quickly if divided or grown from cuttings. Tweezers are useful, seeds are tricky to find and cuttings are tiny

#### DIVISION

Divide plants such as A. lanuginosa, A. sarmentosa, and A. sempervivoides after flowering (see p 167) into single or several rosettes, to flower the next year

#### SEEDS

Sow seeds (see p. 164) as soon as tipe, if possible, old seeds tend to have poor or effatic germination. Use gritty soil mix, which must be sterile to avoid weeds or disease overwhelming the tiny seedlings Sow in pots and keep in a sheltered place outdoors. Seedlings are initially slow to develop; delay transplanting them until the following spring or even the next one. Plants flower in 2–3 years.

#### CUTTINGS

Take stem-tip or rosette cuttings (see p 166) of larger, leafier types, root in a gritty soil mix. Cushion-forming types are tricky. Take single rosette cuttings or small clumps that have roots and insert in pure gritty sand or ground pumice (see p 167). Plants flower in two years.

# ANTHURIUM



Anchariam andraramam

DIVISION IN early spring 4.
SEEDS IN AUGUSTION OF Spring 4.

These evergreen, tender perennials, many of which are epiphytic may be divided (see p 148) to flower in 1~2 years. Take care not to damage the fragile

roots. Sow seeds (see p 151), as soon as they are ripe or in spring, at 77°F (25°C); they may take several months to germinate. Seed-raised plants take several years to reach flowering size.

# ARMERIA THRIFT, SEA PINK

SEEDS in autumn or in early spring I SEEDS in autumn or in early spring I Currings in late samper II

Perennial thrifts are cushion- or matforming plants, most are quite hardy. The woody crowns may be divided (see p 149), plants are also easily raised from seeds (see p 151) in a cold frame. When taking cuttings (see p 166), use semiripe, leafy basal stems, 1%-2in (3-5cm) long, from the edge of the plant. Bottom heat is not necessary, but aids rooting, as will hormone rooting compound.

# ANEMONE WINDFLOWER, ANEMONE



DIMISION in spring or in late summer \$\frac{1}{4}\$
SEEDS when ripe or in spring \$\frac{1}{4}\$
Cuttings in automa or in winter \$\frac{1}{4}\$

Rhizomatous anemones tend to flower in the spring, fibrous-rooted

herbaceous species usually flower in tate summer or autumn. (For tuberous species, see p.261.) Woodland anemones divide well, but Japanese anemones may suffer a check in growth and are better grown from root cuttings. They may also produce plantlets around the parent where roots are damaged, these can be lifted and transplanted with care.

#### DIVISION

Divide late-flowering types, such as Anemone multifida, in spring. Cut clumps into 2—4 sections and replant where they are to flower Spring or early stimmer bloomers, such as A canadense, are better divided immediately after flowering. The first group should flower the same year, the latter in the next year.

Divide thizomatous species (see p. 149) when dormant or, to locate them without causing undue damage, as their leaves die down. Cut the rhizomes into sections, each with at least one bud, and replant immediately before they dry out. They should flower in the following season.

#### \$FFDS

Anemone seeds germinate most successfully if sown thinly as soon as they are ripe. Fresh, spring-sown seeds

(see p 151) kept at 60°F (155°C) should germinate in three weeks. Seed-raised plants flower in their second or third season. Sow in moist, gritty soil mix tadding leaf mold for woodland species such as A apennina and A nemorosa)

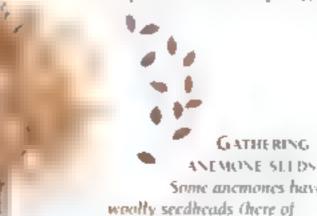
Transplant fibrous-rooted seedlings when large enough to handle. Seedlings of thisomatous anemones are best left to grow on in their pots for 12 months before transplanting, hquid feeds during this period, when they are in active growth, help seedlings grow strongly.

Woodland species, for example

A. apennina, some forms of A. nemorosa,
and A. multifida, often self-sow.

#### CUTTINGS

To avoid disturbing Japanese anemones, uncover the edge of the clump and take root cuttings (see p 158). They usually flower in 2–3 years. For A. sylvestris, pot a plant in spring, in autumn, lift it and slice the root ball across, about 2in (5cm) below the crown. Repot both parts, lightly covering the cut roots on the lower root ball with Ain (1cm) (of grit or soil mix, after a month or so, shoots will appear. Both parts may be divided and planted out in spring



Some anemones have woolly seedheads (here of A multihida). Some seeds will fall out naturally, the remainder can be sown within the "wool

# ARTEMISIA MUGWORT, WORMWOOD, SAGEBRUSH

DIVISION EXPENSE!
SEEDS THE THE SPENSE!
COTTINGS THE SPENSE!

The herbaceous or woody-based perennials in this genus are easily divided, and some forms root rather easily from cuttings. Seed-raised plants take longer to mature

#### Division

Lift and divide clumping plants, such as A. lactiflora and A. ludoviciana (syn A palmeri), into moderate-sized pieces for replanting at once (see p. 148), they make effective plants the same season

#### SEEDS

Sown seeds (see p 151) may be placed in a cold frame – or at 61°F (16°C) to germinate within two weeks. Plant out seedlings in the following spring

#### CUTTINGS

Take stem tips or heeled sideshoots as greenwood cuttings (see p 154) in late summer, except from A. absinthium 'Lambrook Silver', which roots best from softwood cuttings taken in spring. Plant out in the next spring to mature in 1–2 years. A. 'Powis Castle' will not survive severe winters, take cuttings in summer

# ASPIDISTRA CAST-IRON PLANT AUBRIETA AUBRETIA

Division in spring \$

All species are essentially tender. Divide the woody rootstock using a knife (see p.148) to cut clumps into small pieces of rhizome with roots. Pot the divisions singly, keep at 59°F (15°C) until new toots are growing strongly.

# ASTER

DIVISION IN Spring ! SEEDS in spring 1 CUTTINGS in spring 1

Perennials in this genus (syn. Crinitaria, Microglossa) benefit from annual or biennial division, which makes them less prone to mildew Divide the tight. woody crowns with a spade or backto-back forks (see p 148). Crowns pulled apart into single rooted shoots. replanted 2-3in (5-8cm) apart, normally flower in the same year Seeds sown (see p. 151) at 59°F (15°C) should germinate in two weeks and flower in their second year Pink-flowered cultivars usually produce mauve offspring Basal shoots work best as cuttings (see p 156), but stems can be used if material is scarce. Root the cuttings in pots or a moss roll (see p 155) in a closed case or on a mist bench, pot and grow on in a cold frame



DIVISION A 1-1 Plantering Hart early autumn 11 SEEDS when ripe or in early CUTTINGS in late summer and in early autumn !

Toy

There are 12 species of mat- or mound-forming plants in this genus, but

only cultivars of Aubricta cultorum are commonly grown. Taking cuttings is the most reliable method of propagation for cultivars

#### DIVISION

Clumps may be carefully lifted and divided (see p 148). Cut back the foliage on divisions to reduce moisiure loss

#### SEEDS

Aubreuas are easily raised from seeds (see p. 151), but the seedlings will vary

#### CUTTINGS

Take ripewood cuttings when the shoots are well matured by the summer sun Ripe shoots are brittle use a scalpel or craft knife when preparing cuttings (see right). Do not pull off the lower leaves, or the stem may break, instead use a sharp blade, cutting upward Alternatively, cut back foliage after

Dowering and take semi-ripe cultings from the new growth. Insert cuttings upto their leaves in gritty soil mix in potsor trays and place in a covered nursery bed. Pot as soon as well-rooted (in 3-5) weeks) to grow on, then plant out later in the autumn or the following spring



TAKING RIPEN GOD CUTTINGS OF AUBRETIA Select strong, nonflowering shoots no longer than 201 (5cm), preferably half this large to or the lower half of each rutting of leaves, cutting apward close to the stem. Make an angied curat the base below a node. Remove any yellow leaves, which may not from the rosetti

#### OTHER PERENNIALS

ANEMONOPSIS MACROPE VILLA Divide with care in spring (see p.148) []. Sow seeds (p.151) as soon as tipe: winter cold needed to break dormancy, germination can be erratic 111 ANGELICA Sow seeds (see p. 151) in spring at 50°F (10°C) 1. ANIGOZANTHOS DIVIDE IB WIRTH areas in autumn, or in spring (see p.148) \$. 50w seeds (p.151). when ripe or in spring at 59°F. (15°C), germination can be slow, hot water (p.152) or smoke treatment (p 20) helps 11 ANTENNARIA DIVIDE (see p. 148) after flowering or detach rooted plantiets: pot small pieces (p 149) 1, Sow seeds (p 151) when tipe or in spring, in gritty soil mux; keep in a cold frame [ Do not overwater ANTHEMIS Sow seeds (see p 151) in spring at 59°F (15°C) 4. Take semi-ripe cuttings of herbaceous types (p.154) in early autumn 4. Take basal stem cuttings of alpines (p. 166) in late spring or early summer 1.

Anthericum Divide (see p. 148)

after flowering L. Seeds (p.151). in spring at 50°F (10°C) 1 ANTHRUSCUS As for Angelica 1. See also Chervil p 290 ANTIBRIL SUM Sow seeds (see p 151) in autumn or spring at 59°F (15°C) L Softwood cuttings in late spring, semi-ripe cuttings in early autumn (p 154) [ AQUILEGIA Sow seeds fresh in late spring or early summer (p 151) at 50°F (10°C), sow old seeds in autumn and expose to winter cold, gather seeds from isolated plants, hybridizes and self-sows very freely 1. Take basal stem cuttings (p. 166) in early summer of choice alpines II. ARABIS Divide in autumn or early spring see p 167) or detach rooted pieces of mat-forming species 1. Sow seeds (p 164) in autumn, or

in spring at 50°F (10°C) [

Root stem-tip cuttings

,p. 166) in summer 1

ARCTOTIS (syn Venidioarciotis, Venutum) As Gazania (p. 197) [ ARENARIA As for Arabis 1 Annaki w. Divide rhizomes (sec. p 149) as plants die down in summer & Sow seeds as soon as npe (p 151) at 59°F (15°C) \$ ARISTEA Detach rooted leaf fans (p 149) in early spring 4. Seeds (p 151) in spring at 61°F (16°C) [ ARNICA As Anthericum ARTHROPODIEM Divide in spring (see p. 148) 11. Sow seeds (p. 151) in spring at 50°F (10°C) 1. ARUNCUS Divide (see p 148) in

spring 4. Seeds (p.151) in autumn at 50°F (10°C) 11 ASARINA PROCEMBENS

(syn. Anturhinum asarina) 50w seeds in spring (see p.151) at 16°C (61°F) 1 Take stem-tip cuttings (p.154) in spring or summer 🚻 ASCLEPIAS SOW seeds (see p 151)

AQUILEGIA CRIMSON STAR

in spring at 59°F (15°C) L ASPARAGUS Divide (see p. 148). when dormant 1. Extract seeds from berries and sow (pp. 151-2) m spring at 59°F (15°C) & (Sec. also Vegetables, p.294) ASPRODELINE Divide carefully after flowering (see p 148) divisions taken at other times are prone to rot 11. Sow seeds in spring (p.151) at 59°F (15°C) 1 ASPHODELUS As for Asphodeline ASTILBE Divide carefully in early spring (sec p. 148) 11. Seeds have short viability, sow (p.151) in autumn expose to winter cold 11 Astrantia Divide in spring (secp 148) L. Seeds (p.151) when ripe or in spring at 50°F (10°C) \$ AURINIA Sow seeds (see p 151) in autumn or early spring at 50°F (10°C)]. Take 11-2in (3-5cm) greenwood stem-up cuttings (p 166) in late summer 1. AZORELLA Saw seeds (see p. 164) in gritty soil mix when ripe or in autumo, or in early spring at 50°F (10°C) L. Take rosette cuttings (p 166) in spring or summer 111

# BEGONIA



spring 44 STEM CUTTINGS in autumn or in spring LEAF CUTTINGS from late spring to early summer 🕻

Begonia Organdy

Most perennials in this genus are tender

DIVISION in early spring 1

SEEDS when ripe or in

Rhizomptous begonias, such as Begonia bowerue, B. manicata, and B rex may be divided. The popular Semperflorens begonias used as bedding are usually grown from seeds, although basal stem cuttings can be taken. Leaf cuttings root readily from B. rex, B. masoniana, and many others, possibly all species and forms, For tuberous begonias, see p 262

#### DIVISION

Divide thizomes (see p.149) into sections with at least one growing tip and pot individually Older, leafless portions of rhizome may be cut into 2in (5cm). pieces and lined out in travs of rooting medium. Keep moist at 70°F (21°C) When shoots and roots have formed. usually after six weeks, they can be potted singly and the temperature

reduced to 59°F (15°C) Plants should reach a good size in six months

#### SEEDS

In cool chimates, sow the fine seeds (see p. 151) at 70°F (21°C) in spring, in warm regions, sow also when seeds ripen. Do not cover the seeds - light is required for germination. The seedlings appear after 2-3 weeks and are transplanted as soon as they are large enough to handle B. semperflorens should flower in 3-6 months, other species may take a year

#### CLTTINGS

Stem-tip cuttings (see p. 154) can be taken from all stem-forming begonias They should root within a month at 70°F (21°C). Cuttings from most of the winter-flowering begonias are best taken in spring

Leaf cultings (see p 157) are prepared with a portion of stalk, 1 in (2.5cm) long, inserted into the soil mix so that the leaf rests on the surface. At 70°F (21°C), plantlets form in about six weeks. To produce more plants from the leaf, cut through the main veins or cut the leaves into small squares (see below)

# BERGENIA ELEPHANT'S EARS

DIVISION IN AUTOMO OF Spring 1 SEEDS in spring [] CUTTINGS IN AUTUMN OF Spring !

Older plants of these perennials form a mass of woody, creeping rhizomes, often on the soil surface, with leaves only at their tips. If just a few plants are required, these may be detached For large numbers of new plants, take rhizome cuttings

#### DIVISION

After flowering or in autumn 11 and sever new plantlets from the ends of the long rhizomes (see p. 149 and below) and replant, leaving the parent in place Plantlets flower the next year

#### SEEDS

Sow seeds (see p. 151) in trays. They will germinate, without extra heat, in 3-6 weeks. New plants flower after two years



DIVIDING BURGENIAS

Calceolaria

SEEDS its spring and summer 11

CUTTINGS in early autumn or spring 11

SLIPPER FLOWER

Divide plants in early spring, ensuring that each piece has a good rosette of leaves and about 6.0. (15cm) of the come with roots. Tran off largebeen some her word loss. Replant deeper dom before if the parent rhizomes were on the surface

# TAKING LEAF CUTTINGS FROM BEGONIAS



T Select a fully grown healthy leaf there of 🗘 a Rex begonia). Using a sharp knote-cut off the hal stack and then straight across each of he mean veris on the iniderside of the leaf

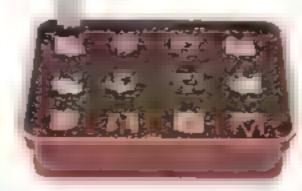
free terms heep them in so a with soil max



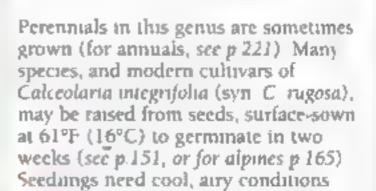
The leaf, cut side down, onto the surface at a tray of rooting median or verniculity label. Keep humid at 70°F (21°C) until planifets develop, usually in two months

# SQUARE LEAF CUTTINGS

Secure cuttings with pins over veins



Cut squares, about 1 in (2 5cm) across, from a large, healthy leaf. Each square must have a main vein running through it. Pin them, veins downward, into a tray of moting medium and treat as in steps 2 and 3 (left)



Take semi-ripe heel cuttings (see p 154, or for alpines p. 166) in autumn and overwinter with cold protection, or overwinter stock plants to supply cuttings in spring. They root easily in two weeks. Plant out in late spring

Detach individual rosette cuttings (see p. 166) from alpine species in summer and root in a gritty soil mix.

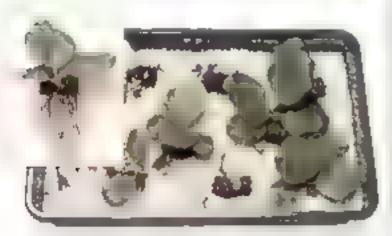


When the plantlets are large enough to I handle, lift the leaf and carefully separate the plantlets. Take-are to preserve some medium around the roots of each one. Pot marvidually into 3in (8cm) pots of soilless potting mix to grow on. Water and tabel

#### BERGENIA RHIZOME CUTTINGS



1 Cut older pieces of leafless rhizame into ▲ 12—2in (4–5cm) sections, each with several. dormant bids. Trim any long roots. Half bury the sections, bads appermost, about 201 (5cm) apart in trays in moist perlite or soil mix. Label



→ Keep the cuttings at a hound 70°F (21°C). In a heated closed case. After 10-12 weeks, plantiets (here of B. conditions) should have moted. Pot singly or line out in a nursery bed

#### CUTTINGS

When dividing Bergenia, cut the remaining, older parts of the rhizomes, which are devoid of leaves, into sections Place in trays of soil mix or perlite with their upper surfaces exposed (see above) After watering, place them in a heated closed case or cover with a sheet of plastic or glass to prevent dehydration Keep shaded at 70°F (21°) to root. The new plants can be planted out in spring Expect flowering within 12-24 months

# CAMPANULA BELLFLOWER



Campaniata 3 Fig. Plan

Division in early autumn or in spring 1 SEEDS in autumn or spring 🕽 COTTINGS in late spring or in earh summer 11

The perennials in this genus include alpines as well as sturdy herbaceous plants

Some smaller types, such as Campanula rotundifolia, self-sow invasively and are a ready source of divisions and cuttings

#### DIVISION

Divide the fibrous or woody crowns (see p 148) to increase cultivars and good forms. Self-rooted shoots or plantlets on runners may be detached from the fringes of many Camponula, especially the alpine species (see p 167), without lifting the parent plant. Keep potted sections in a sheltered place to establish

#### SEEDN

Sow the fine seeds thinly (see p 152) and cover lightly. Spring-sown seeds should

# CANNA

DIVISION IN Spring SEEDS in spring \$41

These tender plants must be lifted to overwinter dry under cover in cold climates. Divide the rhizomes (see p 149) and start them into growth at 61°C (16°C) for flowers in the same season. File or hot-water treat the seeds to break their seed-coat dormancy before sowing them. Sow the seeds (see p. 151) at 70°F. (21°C) Seed-raised plants usually flower in their second year.

be kept at 60°F (15.5°C), if sown in autumn, pots or trays of seeds may be placed in a cold frame. Plant out seedlings of more robust perennials in the summer or autumn of the first year Overwinter seedlings of smaller alpines (see p. 164) in their containers and not them in the spring. Sow C. pyramidalis and C. medium as biennials (see p.221)

#### CUTTINGS

Nearly all alpine species may be grown from basal stem cuttings (see p 166), inserted in gritty soil mix, preferably in late spring. Roots should form, without bottom heat, in 2-3 weeks, Take stemtip cuttings of herbaceous species (see p 154) from new growth after flowering Take root cuttings (see p.158) from

C. glomerata in winter

ATPINE BELLFLOWER CUTTING Rosette cuttings about son (Icm) long may be taken from many aipine bellflowers there or Campanula cochlenratolia.

# CARDAMINE BITTERCRESS

Division after flowering or in early autumn 1 SEEDS when ripe or in early spring 1 CUTTINGS in early spring 🚻

Many of the perenmals (svn Dentaria) in this genus have fragile rhizomes: divide with care, any fragments can be potted. Sow seeds (see p. 151) at 50°F (10°C), keep rhizomatous seedlings in their pots for a year Weighting a leaf of C pratensis or its cultivars onto soil may induce a plantlet to form; this species also forms bulbils (see p.26) below or at soil level

#### OTHER PERENNIALS

BELAMEANDA Divide (see p. 148 keep in a cold frame 11 in spring 4. Sow seeds (p. 151) in spring at \$9°€ (15°€) 1 Dialis Divide cult vars after flowering (see p 148) 1. Sow. seeds (p 151) for spring beading in midsummer 1. BERTOLONIA Seeds (see p 151) in spring at 70°F (21°C) L Stem-tip cuttings (p 154) in spring L BIDENS Sow seeds (see p 151) in spring at 59°F (15°C) L Take stem-tip cuttings (p. 154) in spring or in early autumn 1 BLANDFORDIA Separate clumps in spring or after flowering (see p. 149) 11. Sow fresh seeds (p. 151) in spring at 59°F (15°C) ↓. BOLAX Detach rooted offsets (see p 166) 11. Sow ripe seeds (p 164).

BOX TONIA Divide (see p 148) in early spring §. Sow seeds (p. 151). in spring at 59°F (15°C) L BORAGO Divide B pygmnen (see p 148) 4. (Annuals, see p 291.) BOYKINIA Divide (see p 167) in late winter or early spring [] Sow seeds (p 164) in spring. keep in a cold frame II BRACHYSCOME (sym. Brachycome) Sow seeds (see p 164) in spring at 64°F (18°C) few viable seeds are produced 1. Take basal stem cuttings (p 166) in spring 4. BRUSSERA Divide after flowering (see p.149) 1. Seeds (p.151) in spring at 50°F (10°C) 1. Take root cuttings (p.158) in winter 1. BUILBINE As for Belamcanda 1.

BURBINELLA Divide (see p. 148) in suitable shoots may be few 11. autumn 4. Sow npe seeds (p 151) keep in a cold frame 1. BUTHTHALMUM Divide in spring (see p 148) & Sow seeds in spring (p.151) at 50°F (10°C) & BUPLEUM 30 As for Buphthalman CALAMINTHA Divide in spring (p 148) or lift rooted stems 1 Seeds (p 151) in spring at 50°F (10°C) 1. Take semi-ripe cuttings (p 154) in early autumn [ CALANDRINIA Sow seeds in spring at 59°F (15°C), as for Lewisia (see p 202) 11 Sow seeds of alpines in autumn (p.164), overwinter in sheltered place to break dormancy for best results & Root rosette cuttings of alpines (p 166) in sand in summer

CALATHEA Divide (see p 149) in late spring & Sow seeds (p 151) m spring at 70°F (21°C) 1. CALLISIA (syn. Phyodona) Divide (sec p 148) in spring 1. Seeds in spring (p.151) at 63°F (17°C, 4. CAREX Divide in spring (see p.148), pot or grow on single rooted shoots in nursery bed (p 149) 1. Sow short-lived seeds (p. 151) in autumn if possible, or in spring at 59°F (15°C) 11 CARLINA Sow seeds (see p 151) in spring at 59°F (15°C) 1. CATANANCHE Divide in micspring (see p.148) 1. Sow seeds (p. 151) in spring at 59°F (15°C). 44. Take root cuttings (p.158) in winter !!

# CELMISIA NEW ZEALAND DAISY

SEEDS when ripe or in autumn [].
CUTTINGS in late spring [].

Perennials in this genus are self-sterile they usually set seeds only if several plants grow together. Sow seeds (see p 164) at 50°C (10°C). Keep moist and semi-shaded until established. Take rosette cuttings (see p 166), some species root well in pumice (see p 167). It may be possible to detach rooted rosettes from larger plants, treat as cuttings until established. Divisions or cuttings must never dry out, mist them daily but do not overwater, which leads to rot

# CHLOROPHYTUM SPIDER PLANT

PLANTLETS at any time # Division in spring #

Vartegated forms of Chlorophytum comosum are the most commonly grown of these tender plants. Their attraction lies in the plantleis that often develop at the ends of old flowering stems. Plantlets develop immature roots while still on the plant and may be detached and potted. If unrooted, remove with a portion of stem, insert into pots of soil mix and keep at 59°F (15°C); they should root within ten days.

Division (see p. 150) produces mature plants more quickly Grow on the new divisions at 59°F (15°C)

# **CHRYSANTHEMUM**



Chrysanthenum Wonne Arnaud DIVISION IN SPRING L SEEDS IN SPRING L CUTTINGS IN SPRING L

Of the large-flowered perennials, or florists chrysanthemums, in this genus (syn Dendranthema), the

hardy, most others are much less hardy (For annuals, see p.222) It may be possible to pull apart the rootstock (stool) of hardier types (see p.148). If replanted in fertile soil divisions should flower in the same season with renewed vigor

Sow seeds (see p 152) of cushion and cascade chrysanthemums at 59°F (15°C). Seeds germinate in two weeks, and plants flower in the same year

Take 2-3in (5-8cm) basal stem cuttings from garden plants (see pp 156-7) or, for larger numbers, from stock plants overwintered in pots under cover. Root in trays of rooting medium at 50°F (10°C). Pot rooted cuttings and grow on at 50°F (10°C). Plant out or pot on in late spring to flower the same year.

# CONVALLARIA LILY-OF-THE-VALLEY



Consadaria majalis DIVISION in spring or in autumn !!!
SEEDS in autumn !!!

The thin, creeping rhizomes of Convallaria majalis can be invasive. They are best divided (see p. 149) after flowering, although

they tolerate division at any time when not in active growth. Pull apart the rhizomes into rooted portions, each with a bud, and replant them at once For a large number of plants, treat rhizomes as cuttings (see below). Plants rapidly establish to flower the following spring.

Plants are rarely seed-raised because it is so slow. First extract the seeds by macerating the berries (see p.151). Germination outdoors takes at least two winters, plants flower after three years.

#### RHIZOME CUTTINGS



Cut rhizomes into 2–3 in (3–8 cm) sections, each with roots and some dormant hads. Discard any disc iso 1 in weak sections. Treat her as for than root cuttings (see p. 158). The cuttings should develop shoots in spring and may be planted and in automi

# **CORYDALIS**

Division in spring or in early on [1]
SEEDS in early summer or in his sec. [1]

Many of the perennials in this genus (svn. Pseudofumaria) are quite hardy, but some of the fibrous-rooted types, such as Corydalis tomentella, are more suited to alpine house conditions. Rhizomatous types such as C. cherlanthifolia can be divided, others are best grown from seeds (For tuberous species, see p 264)

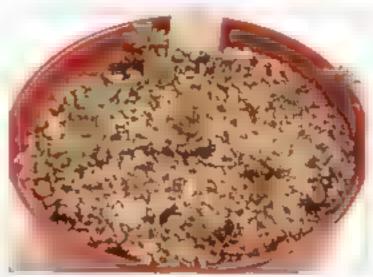
#### DIVISION

Lift and divide dormant rhizomes (see p. 149) carefully. The stems are sappy and fragile and easily damaged by handling Replant large divisions immediately. Pot small pieces to plant out the next year.

#### SLIPS

Sow seeds (see p.151) as soon as they are ripe or in autumn, older seeds have poor viability. Allow them to germinate in a

sheltered place outdoors. Transplant seedlings into small pots when large enough to handle. Many self-sow readily, transplant seedlings carefully.



CORYDALIS SEEDL NOS

Fresh seeds should germine in a few weeks at about 59°F (15°C) but old seeds tend to germinate slowly or erratically. Keep the pot for two years to allow all the seedlings to come up

# DELPHINIUM



Pe pit neum Fan re DIVISION in spring \$
SEEOS in spring \$
GUTTINGS in late spring \$

The easiest way to propagate perennial delphiniums is by division. Several of the cultivars do come fairly true from seeds, others

yield variable offspring that may still be of value. Most delphiniums are quite hardy

Divide mature clumps into 2-4 pieces, discarding the woody center (see p 148). Divisions flower the same year

Sow seeds in pots (see p.151) at 55°F (13°C). Seedlings appear in 14 days, although old seeds germinate erratically. New plants may flower in 18 months.

Take basal stem cuttings from 3in (8cm) long shoots (see p.156), these new shoots should not yet be hollow, one of the factors that make cuttings prone to rot. Insert in rooting medium (some growers put a layer of fine sand in the bottom of the hole) or in perlite (see p.156). Keep at 59°F (15°C) and pot when rooted, after about ten days. Plant out in nursery beds in early summer

# DIANTHUS CARNATION, PINK

DIVISION in spring or in autumn \$\frac{1}{4}\$
Seeds in spring, early summer or in autumn \$\frac{1}{4}\$
CUTTINGS from mid- to late summer \$\frac{1}{4}\$
LAYERING from mid- to late summer \$\frac{1}{4}\$

The perennial species are mostly quite hardy and are increased in various ways according to the type. They can be subjects for hybridizing (see p 21) (See also Annuals and Biennials, p.223.)

#### DIVISION

Some spreading and mat-forming species and cultivars root naturally as they grow These can be divided after flowering

#### **CUTTINGS FROM PINKS**



Hold a nonflowering shoot near the base and pull out the tip. It should break easily at a node giving a cutting 1-4in (8-10cm) long with 3-4 pairs of leaves. Remove the lowest pair (see inset)

into large portions (see p 148), each with up to 20 shoots and some roots. The new plants will flower the next year

#### SEEDS

Sow seeds (see p 151) of pinks grown for summer bedding, such as Chinese or Indian pinks (D. chinensis) in spring at 59°F (15°C) to germinate within ten days. Sow sweet Williams (D barbatus) as biennials (see p.219) in early summer transplant in midautumn Sow alpines in pots in cold frames in autumn or spring A few species self-sow

#### LAYERING BORDER CARNATIONS



1 the leaves from all except the top 3in (8cm of the stem Make a 1in (2.5cm) sloping cut just below the leaves to form a tangue (see inset)

#### CUITINGS

Semi-ripe cuttings may be taken from all Dianthus (see below, left), especially small and alpine species. A hormone rooting compound is helpful. Insert in pots of rooting medium in a frame or closed case; keep moist but not wet Rooting takes 2-3 weeks at 59°F (15°C); plants will flower the next year

#### LAYERING

Carnation stems may be layered (below) into the soil of a plunged pot of rooting medium and should root in eight weeks



2 Prepare the soil below the cut with equal parts of coarse said and moist peat. Gently bend the stem so that the tongue opens out, push a into the soil, and pin securely in place.

#### OTHER PERENNIALS

CATHARANTHUS Sow seeds (see p 151) in spring at 70°F (21°C) 1 Semi-ripe cuttings (p.154) in summer and early autumn 1 CENTAUREA Divide in spring (see p. 148) 1. Sow seeds (p. 151) in spring at 50°F (10°C) L Take root cuttings (p. 158) in winter 🛭 CENTRANTHUS Divide in spring (see p.148) L. Sow seeds (p.151) in spring at 50°F (10°C) L CERASTILM Divide in spring (see p 148) L. Seeds in autumn or spring (p 151) at 59°F (15°C) 4. Take soft stem-tip cuttings (p.154) in early summer 41. CHAMAEMELUM Divide in early autumn or spring (see p 148) [ Sow seeds (p. 151) in spring at 50°F (10°C) 1 CHELONE Divide in spring (see p 148) 1. Sow seeds (p. 151) in spring at 59°F (15°C) L. Take softwood stem-tip cuttings (p. 154) in late spring 1. CHIASTOPHYLLUM OPPOSITIFOLIUM (syn. Cotyledon simplicifolia)

Divide after flowering or in early spring (see p. 148) 1. Sow seeds p.151) in autumn in pots, keep in a cold frame 1. Softwood cuttings (p.154) early summer [ CHRYSOGONE M VIRGINIANEM AS for Centranthus I CIMICIFUGA Divide in spring (see p 148), especially colored-leaf forms 4. Sow seeds (p 151) in autumn germinates poorly 111 CIRSIUM As for Centranthus & CLAYTONIA Sow seeds (see p. 151) as soon as ripe, in a shaded cold frame L Some self-sow CLITORIA Sow seeds in spring after hot-water treatment (see pp 151-2) at 70°F (21°C) 1. Take semi ripe cuttings (p.154) in late summer 1. CEIVIA Divide if not in flower (see p 148) L Sow seeds (p 151) in spring at 70°F (21°C) [ Coponopsis Sow fine seeds thinly (see p.151) when ripe or in autumn, in a cold frame, leave seedlings in pots for a year Most

flower in the third year L LOLEUS See Salenostemon (p.209) Convolutius Divide alpines (see p 167) in spring 1. Sow seeds ,p 151) in spring at 59°F (15°C) Take semi-ripe cuttings (p 155). in early autumn 4. Take heel cuttings in summer from alpines (p 166) such as C beissieri 1 Contents Divide in spring (see p 148) 1. Sow seeds (p 151) in spring at 50°F (10°C) 4. Basal. stem cuttings (p.156) in spring [ COSTUS Divide in spring (see p. 149) 1. Sow seeds (p. 151) in spring at 70°F (21°C) 1. In late winter before growth starts, cut rtuzomes into 2in (5cm) pieces as Bergenia (p 191) 1 CRAMBE Seeds (see p.151) in spring at 50°F (10°C) or

outdoors 1
Take root cuttings in late
autumn (see p.158 and p.299) 1
Chaspedia Divide in spring (see

p 148) § Seeds of alphnes in early spring (p 151) at 50°F (10°C), seeds often have low viability §. CTENANTHE As for Maranta (see p.202) §

CURCUMA As Maranta (p. 202)

CYNOGLOSSUM Divide in spring (see p. 148) §. Sow seeds (p. 151) in spring at 59°F (15°C) §

DARMERA (syn. Peltiphyllum)

Divide rhizomes after flowering (see p. 149) §§. Sow seeds (p. 151) in spring at 50°F (10°C) §

Diametra. Divide rhizomes (see

Diametra Divide rhizomes (see p 149) in midspring I. Sow cleaned seeds in spring in pp. 151-2) at 50°F (15°C) I.

ROSEUS PACIFICA PUNCH

# DIASCIA TWINSPUR



Дим ы н. Бис

SEEOS when tipe of a serie of a life CurmNGS in spring or in late surmier |

Named hybrids of perential Diascia are most commonly grown Plants are self-sterile and do not produce seeds unless more than

one clone or species is grown. Sow seeds (see p 151) at 59°F (15°C) to germinate within ten days. Plants flower in the same year. Deliberate by bridization (see p 21) can have interesting results.

Take softwood stem-tip cuttings (see right and p.154) in spring, or from the regrowth on plants trimmed after flowering. In cold climates, semi-ripe cuttings taken late in the season need protection over winter until late spring in the following year

#### DIASCIA SOFTWOOD CUTTINGS



Diase a cuttangs are best taken in spring or from regrowth in prained stock plants, otherwise the stems tend or be hollow and not when inserted or a consequence to the best with the cutting just below a node

# DIONYSIA

SEEDS in summer or in winter 11
CUTTINGS from late spring to migsummer 111

Apart from Dronysa involucrata and D tenerioides, all species need two types of plant (as for primroses), pin- and thrum-eyed (see p.206), to be grown to produce seeds. Seeds of tight "cushion" forms lie deep within the leaf-rosettes gather them in summer using tweezers

Sow seeds in a very gritty soil mix (see p 164) the moment they are ripe or in winter, then keep in an airy, slightly shaded cold frame to germinate. Transplant seedlings into a mix of one part peat, one part soil, and three parts fine grit. To avoid wetting the plants, immerse the pots up to their rims in water, then allow to drain. Plants flower after their second season.

Take single rosette cuttings, %=700 (5-15mm) long (see pp 166-7), insert in crushed pumice or horticultural or fine sand. Keep in a partly shaded cloche or cold frame. Avoid watering until rooted

# DIEFFENBACHIA DUMB CANE

CUTTINGS in spring \$1 LAYERING in spring \$4

These tender perennials are usually increased from cuttings and are probably the only herbaccous perennials that may be air layered. Wash your hands after handling dumb canes or wear gloves the sap can cause an allergic reaction.

#### CUTTINGS

Plants often become straggly with age but basal sideshoots and the leafy stem tips can be taken as cuttings (see p 154) Insert in pots of rooting medium in a closed case at 70°F (21°C). These cuttings should root within three weeks If covered with a plastic bag and left on a windowsill in a warm room, cuttings will root, but in about 51x weeks. You can take stem cuttings, too, cutting the main stem into sections, each with a single node (see right). New shoots should appear within six weeks. The severed main stem of the parent plant should also produce fresh growth, as long as the lowest bud is retained

#### LAYERING

Air layering (see Shrubs and Climbing Plants, p 105) can be used to root shoots while still on the plant. Remove any leaves with their stalks 4-6in (10-15cm) below the stem tip. Make two parallel cuts %in (5mm) apart around the stem, peel off the ring of skin. Slip a clear plastic bag, with the bottom cut open, over the stem, then tie or tape one end below the wound. Pack the bag with moist sphagnum moss, then secure above the moss. After three months or so roots should be visible. Sever the rooted section, then pot to grow on

#### DIEFFENBACHIA CUTTINGS



2 from all but the top safe shoots and shoots and shoots and above the fowest node.

2 from all but the top safe shoots and point the open step to the fowest node.

sections entered a post below a node



Insert the stem trp
cuttings so that
the feaves rest just
above the surface
Press the stem
cuttings horiz reary
in a fam ours
uppermost one third
buried. Keep the
tootstock in its pot

🔿 Prop. r. ser o pois

# ECHINOPS GLOBE THISTLE

DIMISION on spring |
SEEDS in spring |
CUTTINGS in late gatains |

The perennials in this genus are easy to raise from seeds, alternatively, propagate named cultivars by division or from root cuttings

Divide the woody clumps using a sharp knife or a spade (see p. 148). Plants will flower the same summer

Sow seeds (see p.151) of species in pois and keep at 59°F (15°C). Expect germination in two weeks. Transplant seedlings singly into pots, line out in a nursery bed in late spring. Seed-raised plants should flower in the second year.

Root cuttings (see p 158) may be taken from all species and cultivars. Choose pencil-thick roots and cut into 2–3in (5–8cm) sections.



GATHERING GLOBE THISTLE SELDS

A ben the seedheads are dry and brown cut off

or the server stems and pick off the seeds for

drying and storing

# EPIMEDIUM BARRENWORT



Epimedium to be hybrids DIVISION IN Spring | SEEDS IN SPINING !! CUTTINGS in winter 1

Large clumps of these mostly woodland plants are often divided rhizome cultings are easier to take from grannflarum Lilake young plants. Seeds gathered from garden plants are likely

#### DIVISION

After flowering, pull or cut large clumps into moderate-sized pieces (see p. 148) Divisions flower in the following spring

#### SEEDS

Only forms of Epimedium davidit, some forms of E grandiflorum, and some new cultivars are self-fertile. Seeds may be set and gathered if more than one species is grown Ripening pods split and drop their seeds while still green, so watch carefully Sow seeds (see p 151) in pois in a cold frame as soon as ripe to germinate in four weeks, for flowers after three years

#### CUTTINGS

Take rhizome sections and treat as root cuttings. Lift a clump and wash off the soil with a strong jet of water. Cut off. old leaves. Carefully separate individual rh.zomes, cut these into 2-3in (5-8cm) pieces and trim any overlong fibrous roots. Lay cuttings on the surface of a prepared tray, cover with soil mix. Keep in a sheatered place until they have roots and shoots. Plants flower in 2-3 years

# EPISCIA FLAME VIOLET

Division in spring and in summer L SEEDS in spring 4 CUTTINGS to early or midsummer 1

All of these evergreen perennials (syn Alsobia) are tender. The creeping mats of foliage spread by means of rooting. above-ground stems, or stolons Plantlets are produced at the tips of these stolons and can be detached.

potted singly, and grown on. Rooted plantlets will flower in the same season Surface-sow seeds on moss, as for

Sarracenia (see p.208) at 70°F (21°C) Plants may flower in the second season Take softwood stem-tip cuttings from

nonflowering shoots (see p. 154) for flowers in the following year Rooting is aided by bottom heat of 70°F (21°C)

# EREMURUS DESERT CANDLE, FOXTAIL LILY



Deminio robustas

DIVISION in summer in early autumn [] SEEDS in spring !!

Although quite hardy, the young growth of these plants is often damaged by spring frosts. They have fleshy, thick, but shallow roots

that are very fragile and difficult to lift without damage. Only mature clumps of many crowns should be divided

#### DIVISION

Lift the wide-spreading roots carefully once the leaves have died down. Use a sharp knife to divide the plant into individual, rooted crowns, and trim off the dying stems. If any large roots are damaged, trim them and dust the wounds with fungicide Replant the crowns immediately (see right), or line out young crowns in nursery beds. Place the starfishlike crowns on coarse sand to help prevent rot, especially on heavy soils. Use deep trays instead of pots to

grow on small crowns, keep them in a sheltered place, projected from severe cold. They may flower in two years

#### SEEDS

Sow seeds (see p 151) to germinate at 59°F (15°C), or sow in early summer and place pots in a sheltered place, such as a cold frame. Fresh seeds germinate in two weeks, but older seeds are erratic and slower. Plants bloom in 3-5 years.

> Shallow hole wide estaugh to accomm what spread-out roots

Copierag t p.

Chown sigs on mound of sand



#### RUPLANTING A DIVIDED CROWN

Dig a planting hote, wider it on the roots and tra-- s reep. Make a 2-3m (5-Rem) monad of coarse sand in the bottom. Sit the crown on top so that its growth bild is at soil feed. Fill in-

(see p 204) 11

#### OTHER PERENNIALS

DRENTRA Divide rhizotties in early spring or early autumn (see p. 149), or alpanes such as D extrorawhen dormant in summer (p 167) 11. Seeds when ruje or in spring (p 151) at 50°F (10°C) [] DICTAMNOS ALBOS (Syn-D fraumella). Divide in spring. (see p. 148) | Seeds (p. 151) fresh or in spring at 59°F (15°C) 44. DIETES Divide after flowering (see p 149), may be difficult to reestablish 11. Seeds in autumn or spring (p.151) at 99°F (15°C) [ Dicatalis Surface-sow seeds (see p.151) in spring at 50°F (10°C) [... Dionala Divide (see p. 148) in spring 11. Sow seeds (p 151) in spring at 54°F (12°C) as for Sarracenia (p. 208) plants may take over five years to flower 1 Take leaf currings (p. 157) in late spring or early summer lay leaf

moss, cover with thin layer of chopped moss-keep humid at 70°F (21°C) [1 Deplarmiena Divide after flowering (see p 148) into leaf lans with roots 1. Sow seeds at 59°F (15°C) in spring (p.151) [... DODECATHEON Divide in early spring (see p 167) 4. Sow seeds when ope or in late summer (p 164) 1. If bufbrets form at base (see p.26), detach in autumn, pot and grow on §. Treat single roots with domant buds similarly 🚻 DOBONICEM Divide (see p. 149) after flowering & Sow seeds at 50°F (10°C) in spring (p.151) 1 DRABA Divide in early spring (see p. 148) 4. Sets seeds readily, sow (see p. 164) when ripe or in early spring, keep in a cold frame 1. Take resette cuttings

flat on live moist sphagnum

(p 166) in late summer they need good dramage and may be rooted in pure sand 4. Water from below DROSERA Sow seeds (see p 151) on two parts peat to one part. sharp sand as soon as ripe at 50-55% (10-13°C) L. Take leaf cuttings as for Dionaea 1 Ditas. Sow seeds (see p. 151) the moment they are ripe 1. Take 1-2m (2 5-5cm) ripewood cuttings as for Aubricia (see p 189) in late summer in pots or trays of free-draining gritty soil mix !! Layer strong stems in early summer, cover with peat and coarse sand 1. ECHINACEA Divide in spring (see p 148) 1. Seeds (p 151) in spring at 59°F (15°C) 1. Take root cuttings (p 158) in winter 11. ENSETE Sow seeds as for Muser

FOMEON CRIONANTHA DIVIDE (see p 148) after flowering 1. Sow seeds (p.151) in spring at 50°F C10°C11 EPILOBIUM (S) n. Chamaenerion) Divide in spring (see p 148) 1 Divide mat forming alpines (p 167) in early spring as growth begins & Seeds (p.151) in spring as 50°F (10°C) 1. Take soft stemtip cuttings (p.154) to spring J. ERIGERON As Aster (see p 189) 1. ERINTS Sow seeds (see p. 164) when ripe or in spring at 50°F. (10°C) 1. Take rosette cuttings (p 166) in spring |. Enobium Divide (see p. 148) in spring L. Sow seeds (p.151) as soon as ripe keep in a cold frame & Basal stem cuttings in spring (p. 156) | Semi-ripe stemtip cuttings (p. 154) in summer [...

# ERYNGIUM SEA HOLLY



SEEDS in autumn or spring \$4

CUTTINGS in late autumn \$4

DIVISION in spring 1

The fleshy roots of most of the perennials in this genus make very successful cuttings, although the plants are severely set back by

root disturbance. The short-lived

E. giganteum is monocarpic and can
be increased only from seeds

#### DIVISION

( magain

Divide the tight, woody crowns just before growth starts (see p. 148), using a knife to separate each crown with as many roots as possible. Line out in a nursery bed or replant in the border. They may be slow to establish, but some species may flower in the same season.

#### SEEDS

Sow seeds (see pp 151-2) of species in spring at 50°F (10°C). Seedlings should emerge in two weeks, new plants flower in their second year – or third year for some species. Freshly gathered seeds germinate more evenly than old seeds sow as soon as they are ripe, in autumn, to germinate in the following spring

#### CUTTINGS

Take cuttings from thick roots (see p. 158), cut into 2-3in (5-8cm) pieces Lay horizontally on trays of soil mix and cover with more mix. Keep above freezing over winter. When shoots and fibrous roots appear in the following spring, pot the new plants singly to flower in their second season. Bundles

of cuttings can also be stored upright in pots of sand, barely covered, over winter. In spring, when they sprout, line them out in a nursery bed to grow on Small plants may also be scooped, as for *Primula* (see p. 206).

To obtain cutting material without disturbing the parent's roots, place a container-grown plant (the pot must have big drainage holes) on a sand bed When strong roots have grown into the sand through the holes, remove the pot by cutting under it with a sharp knife (see below). Lift the roots from the sand to use as cuttings or allow them to grow on until spring, then transplant them



OBTAINING MATERIAL FOR ROOT CETTINGS in spring, place a container-grown plant (here Ecyrigium agavilolium) on a sand bed that is at least bin (15cm) deep to encourage the plant to root into the sand. In late autumn, slice under the pot to cut through the roots and free the pot Lift the roots from the sand to use as cuttings

# EUPHORBIA SPURGE



Euphorbia

Division in early spring or from spring to summer \$ SEEDS in autumn or spring \$ COTTINGS in summer or in autumn \$\$\frac{1}{4}\$

Perennials in this huge and very varied genus are tender to very hardy Wear gloves when

handling Euphorbia, since the milky sap can irritate the skin. Most herbaceous Euphorbia may be divided, species increase readily from seeds. Cuttings may also be taken from most species, but especially selected forms. (For succulents, see p. 246.)

#### DIVISION

Those flowering in spring and early summer, such as Euphorbia polychroma, are divided (see p. 148) after flowering Divide late bloomers, for example E sikkimensis, in early spring Single bud division (see p. 150) is possible with fibrous-rooted species

#### SEEDS

Sow seeds (see p. 151) at 59°F (15°C). Germination can be erratic; seedlings may appear over several months. To overcome this, sow in autumn and expose to winter cold, seeds should then germinate more evenly in spring

#### CUTTINGS

Take stem-tip cuttings (see p 154) from mature growth after flowering. Take 2—4in (5—10cm) long shoots and allow to stand for an hour for the milky sap to dry before inserting in trays of rooting medium — or in a moss roll (see p 155) Place in a sheltered place such as a cold frame, excess humidity can cause rol Cuttings take up to one month to root Pot singly and plant out in spring

# ERYSIMUM WALLFLOWER



Erysiniam Bredon SEEDS in midsummer 1 CUTTINGS in summer 1

Some of the evergreen perennials in this genus were formerly known as Chetranthus Species and short-lived cultivars of wallflowers Ervsimum

cherri) and Sibertan wallflowers

E. x alitonii) are usually raised from seeds. Take cuttings from double-flowered wallflower cultivars such as 'Bloody Warrior', cultivars that do not set seeds such as 'Bowles Mauve', and other improved forms of species.

#### SEEDS

Short-lived perenmals grown as bedding are sown as biennials (see also p.219). Sow seeds thinly in rows in seedbeds in

midsummer, then transplant seedlings in early to midautumn

#### CUTTINGS

Take semi-ripe stem-tip cuttings (see p. 154) from nonflowering shoots. Insert in pots of rooting medium and

or no heat. Pot the rooted cuttings singly, after a few weeks. Protect them over winter from severe cold in a cold frame, where necessary

SOFTWOOD WALLFLOWER CUTTING Nodal cuttings (here of Erysimum limitohum) root easily. Remove a nonflowering shoot with 3-4 nodes, cutting below a node. Frim off the lower leaves

# FITTONIA NERVE PLANT

Ovision in spring |
SEEOS in spring |
COTTINGS in spring or in late summer |

These tender, evergreen perennials have freely rooting, creeping stems. Divide established plants (see p. 148), pulling the clumps into small, rooted pieces. Pot these individually and keep at 64°F (18°C) until established, when the temperature can be lowered to 59°F (15°C). Seeds should germinate in three weeks if sown (see p. 151) in containers at 64°F (18°C).

Take softwood stem-tip cuttings (see p.154) from new shoots in spring or from mature shoots in late summer, and insert into trays or pots. At 64°F (18°C), rooting should take 14 days

# FRAGARIA STRAWBERRY



SEEDS in early spring or in late summer & LAYERING in summer &

Fragaria s ananassa cu livar

These perennials include the fruiting strawberry and the alpine strawberry. Most strawberries produce

DIVISION in late summer &

plantlets on creeping, rooting stems ("runners," or stolons), a natural method of increase which can be encouraged by layering to provide a convenient method of propagation. Some strawbernes do not produce runners, however, and must be increased by division or from seeds. Strawbernes are susceptible to virus infection, and it is important to propagate only from healthy plants.

#### DIVISION

Some perpetual-fruiting cultivars do not produce many runners, so clumps may be propagated by standard division (see p.148). New plants should fruit in the following summer.

#### SEEDS

Alpine strawberries such as 'Baron Solemacher' do not produce runners and must be raised from seeds (see p 152)



GATHERING ALPINE STRAWBERRY SEEDS Allow ripe fruits of alpine strawberries (here of Fragaria vesca 'Semperflorens') to dry. Rub gently over a clean dish to gather the seeds



ROOTING RUNNERS OF STRAWBERRIES
Keep the soil moist and remove all the flowers
from a plant to encourage runners. As they form
peg the runners down to aid rooting. In late
summer, carefully lift the rooted plantlets, sever
them from the parent, and pot or plant out

sown at 64°F (18°C) in early spring Fresh seeds may be sown outdoors, or under the protection of a cold frame if needed, in late summer. New plants flower and fruit in the following year

#### LAYERING

Many strawberries have runners that root into the soil, runner production coincides with the end of fruiting on cropping plants. Plantlets form on these stems as they grow. When the plantlets are well rooted, they may be easily severed from the parent plant. This self-lavering habit can be encouraged. Stems may be layered onto the soil (see above) or into pots sunk into the bed.

For best results, keep some plants specifically for layering. Plant these 3ft (90cm) apart and remove the flowers Keep the soil moist to encourage runners to develop and root. Peg runners with wire staples into the soil or into 3in (8cm) pots filled with soil-based mix and plunged level with the soil surface Plant rooted plantlets into their final positions in late summer and autumn for a good crop in the following season

# **GAURA**

Division is spring !!
SEEDS in early spring !
Cuttings in spring or in summer !!

Perennials in this genus thrive in a hot, sunny position with free-draining soil. They are generally short-lived, except for Gaura lindhetmeri. Divide plants (see p. 148) to flower in the same season.

Sow the seeds in containers at 50°F (10°C) (see p 152). Take basal stem cuttings in spring or semi-ripe heel cuttings in summer (see pp 154–7) Plants raised from seeds or cuttings flower in their first or second season

# GAZANIA



SEEDS in spring 1
Cornings from late summer
to early antomic 1

Many perennials in this genus can be raised from seeds sown at 64°F (18°C) in free-draining soil mix (see p.152) to

rigens var uniflora grow as annuals.
Seedlings appear in 14 days and flower in the same season. Gazania rigens (syn G splendens) does not set seeds. Many cultivars will not come true

Take basal stem or semi-tipe stem-tip cuttings (see pp 154-6), if possible from nonflowering shoots or remove the flower buds. Cuttings root readily, even in water; use a free-draining rooting medium to avoid rot. Keep humid, but well-ventilated, until rooted (usually in 2-3 weeks), then pot them, Keep frost-free before planting out in late spring

# GAILLARDIA BLANKET FLOWER



DIVISION in early spring |
SEE08 in spring |
CUTTINGS in late autumn |

Perennials in this genus tend to be short-lived especially on heavy soils. Most new plants flower in one year, cultivars can be divided

or grown from cuttings. (For annuals and biennials, see p 224)

#### DIVISION

Divide the tight crowns into individual, rooted shoots (see p. 150)

#### SEEDS

To save seeds, gather mpe flowerheads and dry for several days, the seeds in the centers should then drop out very easily Sow the seeds (see p.151) at a minimum temperature of 59°F (15°C); they should germinate within ten days.

#### CUTTINGS

Perennial cultivars can be propagated from root cultings (see p. 158). Remove the thickest roots from the perimeter of a clump to avoid disturbing the parent Cut into 2–3m (5cm–8cm) lengths and root with bottom heat of 50°F (10°C).

#### OTHER PERENNIALS

EUPATORIUM Divide in spring (see p 148) 1. Seeds (p.151) in spring at 59°F (15°C) 1. Basal siem eutrings (p. 156) in spring L. EVOLVULUS Seeds at 64°F (18°C) in spring (see p 151) L. Take semi-ripe cuttings in early autumn (p.154) 1. FELICIA (syn. Agathaca) Sow seeds (p. 151) in spring at 59°F (15°C) L Take seini ripe cuttings (p.154) in early autumn 1. FILIPENDULA Divide in spring (see p 149) 1 Seeds (p 151) in spring at 50°F (10°C) 44. Take root cuttings (p. 158) in winter 1. GALAX URCEOLATA (syn. G. aphylla) Divide in spring (see p.148); slow to reestablish 11. Seeds (p. 151) in spring at 50°F (10°C) []. GALEGA Divide (see p. 148) in autumn or spring L Soak seeds in cold water, sow at 59°F (15°C) in spring (pp.151–2) 1. GALSUM Divide after flowering (see p 148) L Sow seeds (p 151) when ripe or in spring, keep in a cold frame 1.

# GENTIANA GENTIAN



Division in early spring or after flowering [ SEEDS from summer to early a construction of the Cuttings in spring of the summer [ ].

Maria Para di

Most perennial gentians are rather long-lived and produce copious amounts

of seeds, which are the prime means of propagation. Some, such as Gentiana saxosa and G. septemfida, may self-sow Larger species such as G. asclepiadea tolerate division (see p. 148). Others, especially mat-forming alpines such as

#### DIVIDING ALPINE GENTIANS



Livide mat forming species there General end acauths) as growth begans in spring Life the plont and gently pad it apart into "thougs - each with roots and a crown of leaves (see inset)

G actualis and autumn-flowering ones such as G. veitchiorum and G sino-ornata increase in the wild by rooted offshoots. Fleshy-rooted types with dense crowns, such as G purpurea and G. latea, resent disturbance once established, so are best raised from seeds or cuttings. For the autumn gentians, use organic-rich, acidic of neutral, free-draining but moist soil mix, spring gentians prefer a less organic, neutral to alkaline mix.

#### DIVISION

Divide rooted offshoots carefully (see below) in early spring to avoid divisions



2 and an he though in a nursery hed in part is in part

rotting over winter. Lift each plant and tease it apart into small pieces with several shoots and fleshy (thong) roots. Sometimes, offshoots can be detached without disturbing the parent. Replant or pot them immediately. Divide larger plants in the usual way (see p.148). All new divisions will die if they dry out spray with water twice daily during dry periods. Plants should flower within a year if damage is kept to a minimum.

#### SEEDS

Seeds decline in viability fairly quickly so are best sown (see p 152) as soon as ripe. Autumn-flowering gentians need an acidic seed soil mix. Sow the fine seeds thinly to avoid damping off (see p 46). They germinate in 4–5 weeks, but the tiny seedlings often develop slowly transplant seedlings singly into pots once large enough to handle. New plants flower in 2–5 years

#### **CLTTINGS**

Take softwood stem-up or basal stem cuttings, especially of autumn-flowering gentians. Insert in pots in a mix of equal parts coarse sand and peat and keep at 59°F (15°C). Once rooted, pot the cuttings individually and grow on in a cold frame or alpine house (see p.154).

# GERANIUM CRANESBILL

DIVISION in late summer automit or early spring [ SEEDS when ripe or in early spring [ STEM CUTTINGS in late spring or in the summer [ ] ROOT CUTTINGS in automit [

Division every 3-4 years helps the perennials in this genus maintain vigor Species hybridize readily, and some self-sow. All species and some cultivars may be raised from seeds. Only a few species, including G sanguincum and G, macrorrhigum, form stems suitable to use as cuttings, take root cuttings from G pratense, G phaeum, and G sanguineum

#### DIVISION

Divide (see p 148) to flower in the first year Loose, fibrous clumps are easily pulled apart. Tight, woody rootstocks must be cut or pried apart. Single bud divisions (see p 150) are possible

#### SEEDS

Seed sown at 59°F (15°C) should germinate within 14 days (see p 151) Plants should flower the following year

#### CUTTNOS

Take basal stem cuttings (see p 156) in spring or when growth has ceased. Cut at, or just below, ground level. Stems of trailing plants such as 'Ann Folkard' can be cut into sections in spring, each with one node. Root in travs in shade at 59°F (15°C). Rooted cuttings flower in a year

Take root cuttings from alpines (see p 167). Lin (2.5cm) long scatter like large seeds over soil mix in a tray and just cover. Root in a cold frame outdoors and transplant in spring. Some species, especially alpines, can be increased from self-rooted cuttings (see p. 167)



RIPENING GERANICAL SEEDHEADS

Ripe seedheads eject the seeds suddenly, so check
daily and gather the pods when they turn brown
but before the "beah" unfurls. Keep them in a
paper bag until they release the seeds

# GUNNERA



SEEDS in summer an imm 11

Divide large types (see p 148) before growth starts into single crowns in midspring, or sow seeds as soon as ripe from round fruits in autumn (see p 151) at

59°F (15°C) Divide mat-forming alpines (p 167) in early spring or late summer Seeds of alpines are rarely fertile, sow tresh (see p 164) in pots in a co.d frame

#### OTHER PERENNIALS

GERBERA Divide old plants (see p 148) into single rosettes in spring 1. Sow seeds (p.151) in spring at 59°F (15°C) 1.

Germ Divide (see p 149) in spring 1. Sow seeds (p 151) in autumn outdoors or in spring at 50°F (10°C) 11

Gerena As for Gerbe 1

Gerena As for Gerbe 1

Gerena Divide in spring at 59°F (15°C) 11

Gerena Divide in spring (see p.149) 1

Detach rooted plantlets at any time (see p.24) 1. Sow seeds (p.151) in spring at 50°F (10°C) 11. Take softwood stem up curungs

# GYPSOPHILA BABY'S BREATH

SEEOS when rape or in spring {
CUTTINGS in spring or in summer {
GRAFTING in late winter {
11}

Most perennials in this genus are quite hardy, but a few are less so. Species are normally grown from seeds, grow cultivars, which do not come true from seeds, from cuttings. However double-flowered cultivars of Gypsophila paniculata do not root readily from cuttings and are most successful if grafted. Larger berbaceous Gypsophila are deep-rooted and resent disturbance.

#### SEEDS

Sow seeds (see p. 151) of perennial species in pots as soon as they ripen or in spring, and keep at 59°F (15°C) Slugs (see p. 47) and snatls may attack seedlings. (For annuals, see p. 224.)

#### CUTTINGS

Take strong basal shoots (see p 156) if possible, or softwood stem tips (see p 154) as cuttings. Root at 64°F (18°C) in a mix of coarse sand and soil. Plants will flower in the following season.

#### GRAFTING

For grafting (see below), a two year-old seedling of G painculata, with vigorous roots, is used to provide the rootstock. Lift a plant of the chosen cultivar in autumn, pot, and keep in a frost-free greenhouse to force growth slightly. By late winter, there should be strong, new growth on the cultivar, which can be used to provide scions for grafting. Keep grafted plants under cover until late spring, when they can be planted out. They will flower well in the next season.

#### GRAFTING GYPSOPHILA PANICULATA



I then two year plant Clean the sect raised plant Clean the sect was a sor c8-10cm) length from a or clear thick toot cutting straight across the top end and visit angle at the bost

enter of state

Cut down through

2 from any fibrous roots from the toots section and cut back lateral toots room in clean). Mela a some (1-2cm) vertical cut into the top of the stock with a clean, sharp king.



3 table o . In (5-8cm long basal shoot from the cuttvar to use as a secon-Remove the bottom pair of leaves and cut the base arto a z-sin (1-2cm) long wedge shape





5 Secure the graft with plastic grafting tape or ratha to hold it firmly in place. Build the entire graft to prevent device. I Label the porther water thoroughly controllow to drain.



6 Cover the pot with a clean plastic bug kept clear of the graft by four sphi statics to avaid not. Keep in a light place at about 50% (15%) for 4-6 weeks until new growth appears

of variegated G. hederacea cultivars (p.154) in spring J. Can be invasive. Ground J. Can be invasive. Ground J. Sow seeds (p.151) in spring at 70°F (21°C) J. Ground J. Divide in spring, reasons a small rooted shoots from the edges of low huminock forming kinds that dishke disturbance (see p.167) M. Sow seeds (p.164) in autumn, keep in a cold frame JJ. Take rosette cultings (p.166) in late summer bottom heat of 59–64°F (15–18°C) helps M. Gracerka (see p.204) M. Sow seeds in spring at Paeama (see p.204) M. Sow seeds in spring at

when tipe: keep in a cold frame often self-sows \$1. It by each (syn Brachychilan). Divide thizomes while still dormant in early spring (see p. 149) \$1. Sow seeds (p. 151) at spring at 70°F (21°C) \$1. HEDYSARDM Sow seeds (see p. 164) in spring at 59°F (15°C) after soaking in bot water to break dormancy print \$1.

GERBERA JAMESONII CULTIVARS

# HELENIUM SNEEZEWEED



Helenium Sannenwunder

DIVISION in spring {
SEEDS in spring }
COTTINGS in spring }}

Most perennial
Helenium quickly
form large clumps
These are easily
increased by division
every 3-4 years, which

also maintains the vigor of each plant Cut the rootstock (see p. 148) into goodsized portions Most garden Helenium are cultivars and will not come true from home-gathered seeds. Sow seeds (see p.151) in spring at a temperature of 59°F (15°C). Seedlings should emerge in about a week and be transplanted in early to midsummer. They often flower in the next year.

To increase stock of cultivars more quickly, take basal stem cuttings (see p. 156) from new growth when the new shoots are about 3in (8cm) tall. Rooted cuttings may flower in the same season

# HEPATICA

Division in late winter or in spring !!
SEEDS in early summer or in late winter !!

These woodland plants are slow to increase by vegetative means, sowing seeds is recommended, except for named cultivars. Divide mature plants in late winter or after flowering (see p.148) Each crown must have good roots if it is to establish well. Sow seeds (see p.151) the moment they are ripe, or in late winter, in pots in a cold frame. Plants flower after about three years.

# HELIANTHUS SUNFLOWER



Her anchus Capenoch Star

Division in spring |
SEEDS in spring |
CUTTINGS in late spring |

The several perennials in this genus are easily divided (see p 148) the rootstocks may be woody or spread by underground stems

(stolons), which can be invasive Plants will flower the same season. Sow seeds (see p. 151) of species at 59°F (15°C) to germinate in 7–10 days, plants should flower in 2–3 years. Take basal stem cuttings (see p. 156) from 3 in (8cm) shoots, at 59°F (15°C), they should root within 14 days. Plants may flower in the same year. For annual sunflowers, see p. 224; Jerusalem artichokes, see p. 302

# HELLEBORUS HELLEBORE

DIVISION after flowering 1
SEEDS in summer 1

The Lenten rose (Helleborus orientalis, H x hybridus) hybridizes freely but the seedlings are usually attractive; for true offspring of cultivars, plants must be divided. Other species come true

#### DIVISION

Divide hybrids such as H x nigerous when new growth is mature (see p. 148). Young clumps of H orientalts and other species can be pulled apart, but older plants and other species need cuiting or

back-to-back forks. Well-rooted pieces should flower in the following spring.

#### SEEDS

Most species set seeds, and many self-sow (see below). Sow at once (see p. 151) in a seedbed or in trays, they germinate best if exposed to winter cold to break dormancy. They may start to germinate in autumn or the spring and flower in 2-3 years. Dry, old seeds germinate erratically, if at all. If seeds cannot be sown fresh, store in moist sand or moss. Good subjects for hybridizing (see p.21)



GATHERING HELLEBORE SEED CAPSULES

Jest a seed capsule (here of Helleborus
orientalis) by gently squeezing; if it splits to
reveal dark seeds, it is ready to harvest. Wear
gloves to guard against the irritant sap. Keep the
capsules dry and warm until they split (inset)



Self-sown Hellebore Stedlings
Seedlings of many species (here Helleborus
arguitlolius) may be found at the base of the
plant in spring. When each seedling has at least
me true leaf carefully lift it and transplant in
moist fertile soil in dappled shade.

# HELICHRYSUM

Orvision in spring |
Seeds in spring or in summer |
Cuttings from summer to early autumn |

Perenntals in this genus are susceptible to rot if kept too moist, so take care to provide drainage and venilate well fibrous-rooted clumps of perennials, for example H thianschanicum (syntanatum), may be divided (see p 148) into 2-4 sections. Expect flowers later in the same year

Gather ripe seedheads the moment they become fluffy before the seeds blow away Sow (see p. 151) at 55-61°F (13-16°C) Seedlings should appear after two weeks, and plants will flower within two years. Sow seeds of alpines as soon as they are ripe in summer

Take semi-ripe stem-tip cuttings (see p. 154) of new, nonflowering growth and root at 59°F (15°C) in trays. Transplant the cuttings when rooted, usually in about 14 days, or delay potting until late spring. Provide cold protection where necessary over winter. New plants will flower in the following year. Rosette cuttings (see p. 167) may be taken from the alpine. H. milfordiae.

# HEMEROCALLIS DAYLILY

DIVISION in early spring !
SEEDS in autumn or in spring !

The majority of daylilies are very hardy but most of the evergreen types are less so. Divide congested clumps with forks (see p.148), trim off damaged roots completely, and replant. Single bud

divisions (see p 150) are possible; these can be "topped," as for hostas (see facing page). Sow seed of species (see p.151) at 59°F (15°C) to germinate in 14 days, especially if seeds are fresh. Plants flower from the second year. Seedlings from cultivars vary but may be pleasing

# HEUCHERA CORALBELLS

DIVISION in spring \$
SEEDS in spring \$

If not divided regularly, these perennials decline in vigor. Division also preserves the color and leaf variegation of cultivars, but a small number of variegated seedlings also come true, and others may be attractive. After dividing a crown (see below and p. 148), discard the old. woody center. Sow seeds (see p. 151) at 50°F (10°C). Some of the cultivars, such as Palace Purple' come true, Plants flower the next year.



DIVIDING A HELICHERA

Lift the plant once in new spring growth. Take small vigorous sections from around the edge each with good roots and 2-3 shoots (see inset).

#### OTHER PERENNIALS

Heliconia Divide in spring (see p 149) ‡
After hot-water treatment, sow seeds in spring at 70°F (21°C) (pp 151–2) ‡
Helicopsis As Helianthus (see facing page) ‡.

# HEUCHERELLA Divide in autumn or spring (see p.148) ‡

HOUTTUYNA CORDATA Divide in spring (see p 148) §. Sow seeds (p 151) in spring at 50°F (10°C) §. Take softwood cuttings (p 154) in spring §.

Hyroestes Sow seeds (see p 151) in spring at 64°F (18°C) §. Soft stem-tip cuttings in spring or semi-ripe in summer (p 154) §. IBERIS Sow seeds (see p.151) in autumn § Take semi-ripe cuttings (pp.154 and 166) in midsummer §.

IMPATIENS Sow seeds (see p 151) of bedding species and cultivars at 61°F (16°C) in spring (for annuals, see p 225) 1. Take soft stem-tip cuttings (p 154) in spring or summer 1.

INCARVILLEA (syn. Amphicome) Sow seeds (p.151) fresh or in spring; keep in a cold frame L.

INDIA Divide in autumn or spring (see p 148) §. Sow seeds (p 151) in spring at 50°F (10°C) §. Take basal stem cuttings (p 156) in spring §.

IPOMOEA (syn. Mina. Pharb.tis) Sow seeds (see p 151) in spring at 70°F (2.°C \ n bright light (for annuals, see p.225) [1]. Take softwood cuttings (p.154) in spring [... IRESING Stem cuttings in autumn, stem-tip cuttings in spring (see pp 154–5) [...

# HOSTA PLANTAIN LILY



Hosai Hafeyon

SEEDS in spring !!

Most form fibrousrooted clumps, though some are rhizomatous or have creeping, rooting stems (stolons) They can take time to recover from root

disturbance, so divide only when new plants are needed or when plants have outgrown their space

#### DIVISION

Break dense clumps apart with a spade (see right), tease loose, fleshy-rooted clumps apart carefully by hand (see p.22) to minimize root damage. Single buds (see p.150) may be potted or lined out in a nursery bed. Plants will be multicrowned the following year, especially if "topped" (see below) at the same time. Cuts are made through the buds of young divisions lined out in a nursery bed, a multibudded crown will form around the damaged bud. This may flower in the following season and provides material for further division



Dividing A LARGE HOSTA CLI MP

If the clump to be divided has a tough, dense rootstock, chop it into pieces with a spade. Make sure that each piece has 1-3 good buds and trim any damaged roots with a kn.fc.

#### SEEDS

Hostas set seeds freely, gather the flower spikes as the lowest pods begin to shed seeds. Seedlings show much, sometimes interesting, variation, although most species come true from seed. Seedlings from variegated plants retain only one color. Sow seeds (see p.151) at 59°f (15°C), keep seedlings in a cold frame. Plants flower in 2–3 years.

#### PROPAGATING HOSTAS BY "TOPPING"



I When the buds begin to shoot in spring scrape away the soil from around the base of each bud to expose the crown. Use a clean damp cloth to wipe clean the base of each crown, taking care not to disturb its roots



2 Carefully make a small vertical cut through the crown of each bud by pushing through the clean, sharp blade of a scalpel or hinfe. If the crown is thick enough, make a second cut at right angles to the first



3 Ireal each cut with hormone moting compound, then insert a toothpick to keep each wound open. Cover the crowns with soil to the same depth as before, firm, and water well keep moist throughout the growing season



4 By autumn, dormant buds should form around the healed cuts and in the following spring, the new buds will produce new shoots (see above). Divide the crowns in the autumn or in spring into pieces, each with its own bud

# IRIS



ha nduyana

Division in spring midsummer, or admin 1 SEEDS in spring 11

The fibrous-rooted and rhizomatous perennials benefit from being divided every 3–4 years. The species and new hybrids are raised from

seeds. (For bulbous irises, see p 271)

#### **DAVISION**

Divide moisture-loving trises such as Siberians in spring or autumn (see p.148). Lift rhizomatous kinds, such as bearded iris, in midsummer and cut rhizomes into sections, each with roots and a fan of leaves (see p.149), replant, with tops barely covered, fin (15cm) apart. Flowers will be sparse the next year, but good thereafter. Cut rhizomes without growing points into pieces about 3in (8cm) long and put into travs leaving the tops exposed. Shoots will soon appear. They will take two years to flower.

#### SELDS

Iris seeds have germination inhibitors soak in cold water for 48 hours before sowing (see p. 151) in autumn in pots at 61°F (16°C) to germinate in spring Seedlings begin to flower within two years. Never let seedlings of moisture-loving species dry out

# LEWISIA BITTEROOT

SEEDS from mid- to late summer or in early spring & ROSETTE CUTTINGS in summer \$\frac{14}{24}\$
LEAF CUTTINGS in summer \$\frac{14}{24}\$

The principal means of increasing these alpines is from seeds. Lewisia cotyledon cultivars, evergreen species, and several others form offsets that can be used as cuttings. Excess moisture is fatal, so water seed ings and cuttings carefully

#### SEEDS

Sow seeds (see p 164) when ripe or in spring in a free-draining soil mix of one part sterilized soil to two parts each of leal mold and sharp sand. Place in a cold frame L. tweedyi germinates slowly and erratically. Some species hybridize readily; seeds may not come true to type, but seedlings can be very beautiful

#### CUTTINGS

Remove offsets with as much stem as possible (see p. 166). Root in pots in gritty soil mix or lime-free sand, in a shaded closed case or cold frame. Leaf cuttings (see p. 166) may be rooted in the same conditions but are slow to establish and rot readily if overwatered.

# LOBELIA

Division in spring \{
SEEDS in automore in spring \{
CUTTINGS in spring in the owner \{
\}

Some short-lived perennials (mostly Lobelia ermus cultivars) are grown as bedding, but the border perennials, some quite hardy and others less so, may be divided or grown from cultings

#### DIVISION

Separate the crowns of plants such as L. siphilitica, L. cardinalis, and L. lasoflora by hand, or with a hand fork and knife (see p. 148), for flowers in the same year

#### SEEDS

Sow seeds (see p 151) of hardier types as soon as ripe, in a sheltered place. Sow less hardy perennials thinly, at 59°f (15°C), seedlings emerge in a few weeks. Most seedlings flower in the first year.

#### CUTTINGS

Take stem-tip or stem cuttings (see pp 154-5) from border perennials in summer. Flowering stems of L suphilities and L cardwalts can be cut into 2in

(5cm) lengths, remove the lower leaves. They root in three weeks at 64°F (18°C). Protect over winter. Plants flower the next season. For more plants, sphil cuttings vertically, retaining leaves on each. Take basal stem cuttings (see p. 156) of double forms of L. erinus in spring.



PATCHING SEEDITNGS OF BIDDING LOBITIA Large monbers of seedlings for summer hedding one tedrous to transplant. To save time and ensura dense drift of plants, sow seeds less thony and transplant seedlings in small clusters, or patches

# LUPINUS LUPINE



tar nus The Chatelaine

SEEDS from early spring to mid-pring 1
Currongs mid- to fate spring 11

Of the perenmals, only cultivars of Lupinus polyphyllus are widely grown. Unusually many modern hybrid selections, such as the

Gallery Series, and some cultivars will breed true from seeds. Cuttings are the best means of vegetative increase. Many lupines dislike hot weather, moist soils and root disturbance.

#### SEEDS

For even germination, soak seeds for 24 hours in cold water before sowing (see p 152) at 59°F (15°C). The seeds are large and may be space-sown in a seedbed (see p 153) or in individual pots to avoid root disturbance when potting on. Germination should occur within ten days. Plant out in late spring

#### **CUTTINGS**

Take new shoots as basal stem cuttings (see p.156) when about 3in (8cm) tall At a temperature of 59°F (15°C), rooting takes 10–14 days. To avoid the risk of rot, try rooting the cuttings in perlite instead of medium, as for delphiniums (see p.156). Pot rooted cuttings and grow on in a sheltered place such as a cold frame. Plant out in early summer to flower in the following year.

# LYCHNIS CAMPION, CATCHELY

Division in sammer or in italia cer 1
SEEOS in early spring 1
COTTINGS in spring 1

Divide perennials, except Lychnix x hangeand, in this genus (syn Viscaria) after flowering (see p.148). Divisions Bower in the same or next season. Sow seeds (see pp.151–2) at 50°F (10°C) seeds of alpines are best sown as soon they ripen. Plants grown from seeds flower in 1–2 years. Some species, such as L. coronaria, self-sow freely. A large number of seedlings from color forms should come true. Take basal stem cuttings (see p.156).

# MARANTA PRAYER PLANT

Division in spring | Secus in spring | | Currings in spring | |

Divide established plants of these thizomatous, tender perennials, pulling the clumps apart (see p 148). Grow on divisions at 64°F (18°C) in humidity and bright, indirect light until they are established. Sow seeds (see p.151) to germinate at 64°F (18°C) in two weeks

Take basal stem cuttings (see p 156) when new shoots are 3—4in (8–10cm) tall. Remove the lowest leaves and insert the cuttings in pots or trays in rooting medium. With humidity and bottom heat of 64°F (18°C), cuttings should root within two weeks.

# MECONOPSIS

BLUE, HIMALAYAN, AND WELSH POPPIES



Mecanepsis betonicifolia

Division in late summer or ir carly autumn 11 SEEDS in si inmer ear v adjumn of in spring [ or 1].

Of the often short lived perennials in this genus, the Welsh poppy, Meconopsis cambrica, is easy to raise from seeds

since it self-sows freely. The prized blueflowered species, such as M. betomcifolia, are more difficult, some are monocarpic Selected forms and sterile hybrids are divided

#### DIVISION

Once growth has ceased, divide plants (see p. 148) into single rosettes. Handle the crowns carefully they bruise easily, which can lead to rot

#### SEEDS

Sow seeds of M. cambrica in autumn and expose to winter cold to germinate in spring. Gathered seeds (right) of other species usually come true, although they tend to hybridize. Seeds have short viability gather and sow them as soon

as they ripen (seedlings from summer sowings need winter protection), or store seeds dry in the refrigerator and both. Sow the seeds in cells in soilless. seed mix and cover them only lightly with vermiculite. Keep them moist but not wet. Sowing on moss (see p. 208). prevents the seeds from drying out. At 59°F (15°C), germination takes three weeks. Pot or plant out seedlings in acidic soil mix or lime free soil



GATHERING MECONOPSIS SEEDS As soon as the seed capsules turn brown via them off and leave to dry in a worm place until

the tops open (see inset). Shake out the see is

unto a clean piece of paper, then sow at once

sow in early spring. For best results, do

**MIMULUS** MONKEY FLOWER

DIVISION IN SPITING ! SEEDS in automn or in spring 1 CUTTINGS in spring or in autumn !

Most perennials in this genus (syn-Diplacus) are short lived and so should be propagated regularly. Established plants may be divided. All are easy to raise from seeds but hybridize freely so seedlings may vary

#### DIVISION

Perennial herbaceous species can be divided (see p.148); some have creeping rootstacks

#### SEDS

Surface-sow the tiny seeds (see p. 151) in spring at 43-54°F (6-12°C). Germination usually occurs within two weeks. Hardy species may also be sown in autumn in pots for early flowers, protect during winter in a cold frame, Miniulus self-sow Irecly

#### CUTTINGS

Take softwood stem-tip cuttings (see p 154) Cuttings root within three weeks and may flower later in the same season

#### OTHER PERENNIALS

JANUARA (syn. Jankaga). As for

Ramonda (see p 207) 4 IFFFERSONIA (syn. Piagiarhegoia) D(v.de (see p. l+8) in spring. slow to establish I. Sow seeds p [51] as soon as ripe, at 50°F (10°C) II. Slow growing JUNCUS Divide in spring just as growth begins (see p. 148) 1. Sow seeds (p 151) as soon as ripe or in spring at 50°F (10°C) [1 Karrish shown. Divide in spring see p 149) L. Sow seeds (p 151) in spring at 50°F (10°C) []. Old seeds germinate erratically and slowly. Take basal stem cuttings 10.156) in spring 1 KNAUTIA Divide in spring (sep 148) 1. Sow seeds (p 151) to spring at 59°F (15°C) 4. Basal stem cuttings (p. 156) in spring Ky Phoria. Divide in mid- to late spring, replant large portions. but pot and grow on small tooted shoots (see pp 148-9) [] Sow seeds (p. 151) in spring at 59°F (15°C) 1. LABLAB PL RPL REUS (Syn. Dolichos. lanlah) See Vegetables, p.302 AMIUM (syn. Galcobdolon, Lamastrion) Divide in spring (see p. 148) 1. Sow in spring in a seedbed or at 50°F (10°C) in

pots (pp 157-3) 1. Take stem-tip. cuttings (p.154) in summer \$ LATINGUS Divide in spring (see p 148) 1. Sow seeds in spring at 59°F (15°C) soak first for 24 hours in cold water (pp 151-2) [ For L. odorotus, see p 226 LEONTOPODIUM Divide in spring (see p. 148) 1. Sow seeds (p. 151) as soon as ripe or in autumin 11 LTCASTURAN M. As for Knamma LITTOGESTS Sow fresh seeds (see p (51) at once in organicrich, free-draining, acidic to neutral soil muy, germination is usually poor 111. Take semi-ripe stem-tip cuttings (p /54) in late summer 11 LIMINIS As for Knowled 1 L BERTIA As for Lirape but seeds are in capsules [ LEATEARIA As for Knowna L. LIMOSRIM As for Knautia & LINARIA As for Knumma 1 LINUX Sow seeds at S9°F (15°C) in spring (see p 151) 4. Softwood cuttings in mid-spring or semiripe cuitings (p 154) of woodybased species in summer & LIRIOPE Divide in spring (see p 1491 k Sow seeds extracted from besties (pp 151-2) in spring at 50°F (10°C) L

Lord's (syn Dorygman) Sings in spring (see p 152) at 50° (15°C) soak first for 24 hours in hot water & Semi-ripe cuttings (p. 154) in late summer 1 LUSARIA Divide L. milozog in spring (see p 148) J. Sow seeds direct in spring (p.152) L. (Forannuals, see p 227.) Luzura As for finicus & Lysimacina Divide in spring (see p (48) 4 Sow seeds (p (51) in spring at 30°F (10°C) 1. Stemtip cuttings (p 154) from late spring 4. Root semiripe cuttings of L nummidaria in early autumn in medium or moss roll (pp /54-5) 1 INTEREST AS for Knaudia 1. MACIEMA (SUB-Bocconta) Divide in spring (see p 149) 1. Sow seeds (p. [5]) in spring at 59°F (15°C); self-sows freely 1. Take rhizome sections in winter and treat as root cuttings (p 158) 1 Matva. Sow seeds (see p 151) in spring at 30°F (10°C) L. Take basal stem or stem-tip cuttings (pp 154-6) in spring 1

MARKERIUM SOW seeds esecp 151) in autumn or spring in pots at 50°F (10°C), germination is erratic & Basal stem cuttings p 150) in late summer [ Mazi's Divide in spring 1. Sow seeds (p.164) when ripe or m early spring in pots at 50°l-(10°C) | Detach self rooted cuttings (see p 167) in spring [ Metissa. Divide in spring (see p 148) 1. Seeds (p 151) in spring at 50°F (10°C) L Take semi-ripe cuttings (p.154) in late summer 1

> MENTHA See Mints, p 291 1 MONARDA Divide (see p 149) in midspring, single bud divisions are possible p. 150) 1 Seeds in spring (p 151) at 50°F (10°C) 1. Take stem-tip or basal stem cuttings in late spring (pp 154-6) [ May flower in first year MOR SIA MONANTHOS (syn. M. hypogaca) Sow seeds (see p 151) in winter or early spring in pots, keep in a cold frame 1. Take root cuttings (p 158) in

KNIPHOFIA ALCAZAR

winter months II.

# MUSA BANANA, PLANTAIN

DIVISION in spring 111
SEEDS when ripe 1.

Despite their treelike appearance, these are tender herbs, although Musa basjoo is a bit hardier than most. They produce offsets, or suckers, which may be removed for propagation (see below). Pot offsets singly and keep at 70°F (21°C) until established. Shelter new plants from wind if needed.

Before sowing the large seeds (see p.151), file each carefully on one side, then soak in hot water and allow to cool for 24 hours. Sow one per pot and keep at 75°F (24°C) Expect germination within a month. Grow on seedlings at the same temperature. New plants can grow 10ft (3m) in a year.



BANANA FRUITS AND MALE FLOWER Cultivars (here Musa 'Lady's Finger') grown chiefly as ornamentals rarely set seeds, but if they do, gather and sow as soon as they ripen

# PAPAVER POPPY

DMSION in summer & SEEDS in summer or in spring & CUTTINGS in late autumn &

Perennial poppies are mostly quite hardy Monocarpic species, such as P trimifolium, and smaller ones, such as P atlanticum are difficult to divide but seed freely, so are best raised from seeds, which come reasonably true. Double or Oriental types are mostly cultivars of P orientale or P bracteatum and give mixed results from seeds so are divided or increased from cuttings. (For annuals, see p 228.)

#### DIVISION

Separate a clump into single crowns, each with some strong roots (see p. 148), for flowers next year

#### SEEDS

Gather the seedpods just as they turn brown, before the cap lifts. The small seeds need light to germinate, surfacesow (see p. 151) as soon as they are tipe or in spring at 50°F (10°C) to germinate in ten days. Transplant seedlings as soon as they are large enough to handle they dislike root disturbance. Seed-raised plants flower in the following season.

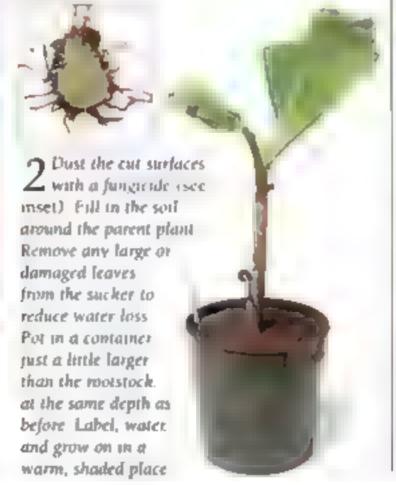
#### CUTTINGS

Oriental poppies reproduce naturally from broken roots left in the soil, so root cuttings usually succeed. They should be 3in (8cm) long, inserted vertically into free-draining soil mix (see p. 158). Keep in a sheltered place over winter. When the new shoots have good roots in spring, line out in a nursery bed or pot singly. Alternatively, root them in sand, as for Eryngium (p. 196). Rooted cuttings flower in the following year.

#### PROPAGATING FROM BANANA SUCKERS



1 Clear the soil away to expose the sucker's point of origin (here of Musa basyon). Use a targe, sharp knife to cut downward and detach the sucker with as many of its roots as possible.



# PAEONIA PEONY

DIVISION IN Early naturns | SEEDS in naturn II

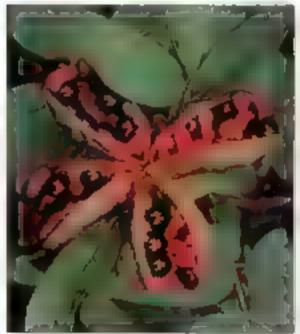
Divide perennials (for shrubs, see p.136) in autumn by separating the tough roots into pieces (see p.149 and right), each with one to several plump, terminal buds. Move them only when necessary; it can take more than two years for divisions to bloom. Cover the buds with no more than an inch of soil, then mulch lightly

The seeds (see p. 151) are doubly dormant. Sow them in pots and leave outdoors to expose them to winter cold. or chill the seeds (see p. 152) for several weeks in the refrigerator before sowing. During the first summer roots develop, but the seeds then require a second period of cold before shoots will appear. Plants may take five years to reach their full flowering size.



DIVIDING PEOMES

When red, swelling buds appear, lift the crown and wash off the soil. Take care not to bruise the fleshy roots. Cut the crown into sections, each with 1-5 buds (see inset). Dust the cuts with fungicide to prevent rot. Replant at least 8in (20cm) apart with the buds just below the surface.



PEONY SEEDHEADS

Some peomes (here Pacoma
cambessedesii produce black and red
seeds in the same pods. Only the black
seeds are fertile, so discard the others
when gathering seeds for sowing

# PELARGONIUM



SEEDS in late winter or in mid-spring 1 SOFTWOOD CUTTINGS ITOM spring to autumn 🖁 SEMI-RIPE CUTTINGS IN BUE summer or in autumn 1

Pelanganium

Commonly known as gerantums, perennial 'A Happy Thought' cultivars of the zonal. regal, ivy-, and scented-leaved geraniums are more popular than the less showy succulent species (see p 249). They are tender and generally perpetuated from year to year by taking cuttings in cold climates, discarding the parent. The single-flowered F1 hybrids of zonal geraniums, commonly used for bedding, are raised from seeds

#### SEEDS

F1 hybrids flower quickly from seeds sown (see p. 151) in late winter at 70°F. (21°C). Seedlings appear in 7–10 days; grow them on at 59°F (15°C). Sow other types in midspring at 59°F (15°C)

#### CUTTINGS

Take softwood stem or stem-tip cuttings after flowering to root in 7-10 days Rooted cuttings need a minimum of 45°F (8°C) over winter; plant out after frost. For early cutting material, in autumn lift, trim, and pot a few plants. Keep fairly dry and frost-free. In late winter, water and keep at 64°F (18°C) to force into growth. Soft cuttings taken then root in seven days. In cool to warm climates, traditional semi-ripe cuttings (see p.154) are less likely to rot, but slow, they root at 59°F (15°C),

# Penstemon

SEEDS in early spring 🜡 CUTTINGS in summer or early autumn 1

Sow seeds (see p 151) of border perennials in this genus at 59°F (15°C), and those of alpines (see p. 164) in a cold frame. It is well worth gathering seeds from good forms; they come fairly true Penstemons are good subjects for hybridization (see p 21)

Penstemon hartwegii Seedlings of border penstemons, such as this, should come fairly true, so they are well worth gathering

Take semi-ripe stem-tip cuttings (see p.154) of all short-lived perennials in late summer to early autumn. Those of smaller alpines should be 1-2in (2 5-5cm) long, border types at least twice as long. In trays, pots or even in water, they should root in two weeks at 59°F

(15°C) They may also be rooted in a moss roll (see p 155) to save space. Pot in free-draining, gritty soil mix to avoid rot, and protect rooted cuttings from cold.

Softwood cuttings of alpines taken in early summer can root well and may flower in the same year

# PEPEROMIA

DIVISION IN Spring | SEEDS in spring 11 CUTTINGS at any time 1

A wide range of selections in this tender genus are in cultivation. Variegated cultivars must be divided to retain the variegation. Seeds are rarely available. Plants with stems, such as P obtusifolia. (Magnolufolia Group), may be increased from stem-tip cuttings; those without, such as P caperata, from leaf cuttings

#### DIVISION

Divide (see pp 148-50) into 2-4 pieces Pot singly, keep humid until established Bottom heat of 64°F (18°C) helps.

#### SEEDS

Sow seeds (see p 151) at a temperature of 70°F (21°C). Transplant the seedlings singly into pots when large enough to handle (usually in 3-4 weeks) and grow on at 64°F (18°C)

#### CUTTINGS

Take softwood stem-tip cuttings (see p. 154) and insert around the edge of a pot. Place in a propagator or in a plastic bag and keep at 21°F (18°C) Cuttings should root within three weeks.

To take leaf cuttings (see p. 157), select mature leaves and remove them with about 2in (5cm) of stalk (petiole) Insert around the edges of small pots filled with equal parts of coarse sand and peat, to a depth of about hin (1cm) Cover to keep humid. It takes about four weeks at 70°F (21°C) for roots to grow, and as long again for plantlets to develop, from the bases of the petioles

#### OTHER PERENNIALS

MYOSOTIDIUM HORTENSIA (Syn. M nobite) Divide carefully after flowering (see p. 148) 111. Sow seeds (p. 151) as soon as ripe or tn sprang at 59°F (15°C) 11. Myosotis Sow seeds (see p.151) in early summer at 50°F (10°C) 50ft stem-tip cuttings (p.154). in summer of species such as M colensol and M pulvinaris 11. (For annuals, see p. 227) NALTHARA IN Sow seeds in spring on moss (see p 208) at 63°F (17°C) L. Take stem-tip cuttings (p. 154) in summer L. NEMES A Now seeds (see p 151) in spring at 59°F (15°C) 1. Take soft or semi-ripe stem-tip cuttings (p. 154) in summer 1. (For annuals, see p.228.) NEPENTHES Sow seeds in spring (see p.151) at 81°F (27°C) L

Take semi-ripe cultings (p.154) in spring 4. Air layer in summer. as for Dieffenbachia (p.194) L. NEPETA Divide (see p. 148) in spring or autumn 1. Sow seeds in spring (p. 151) at 50°F (10°C) | Take soft siem-tip cuttings in early summer, semi-ripe cuttings in early autumn (pp 154-5) 👢 NIEREMBERGIA Divide in spring (see p. 148) 1. Sow seeds (p. 151) m spring at 59% (15%) 1. Take soft stem tip cuttings in early autumn keep frost free in first winter (p 154) 1. OFNOTHERA Divide fibrous rooted species in spring (see p.148) J. Sow seeds (p.151) in spring at 50°F (10°C) L Take softwood cuttings (p 154), especially of taprooted species in late spring L

OMPHALODES Divide after flowering (see p.148) 44. Sow seeds (p. 151) in spring at 50°F (10°C) or in autumn; sow seeds of O. lucilliae and keep in a cold frame 11. OPHIOPOGON As for Liriope (see p.203) L. ORIGANIJM See Culmary Herbs, p 291 OSTEOSPERMUM Sow seeds (see p 151) in spring at 64°F (18°C) | Take softwood cuttings in spring, semi ripe cuttings in late summer (pp 154-5) L OFRINA Divide in spring usee p 149 11. Sow seeds (p 151 m equal parts grit, soil, and leaf mold as soon as ripe or in spring; keep in a cold frame 4. Ovalis Divide rhizomatous and fibrous-rooted plants in early

spring or just after flowering (see pp 148-9) | Sow seeds (p.151) in spring at 55-64°F (13-18°C) 1. (For bulbous and tuberous species, see p 275) PACHYSANDRA Divide in spring (see p 148) 1. Take semi-ripe cuttings (p. 154) during summer and autumn & PARAQUILEGIA Sow seeds (see p 151) as soon as ripe in pots in gratty soil mix keep in a cold frame \$1. Take basa, stem curtings op 1560 in early summer they do not always root 111 Parnassia. Divide in autumn or spring (see p 148) 11. Sow seeds (p.151) in autumn in pots, keep in a cold frame []. PERICALLIS Sow seeds (see p 151) at 59°E (15°C) in spring or summer 1.

# PETUNIA



fett. e de Carpa

Seeds in spring ! Cuttings in summer !

The cultivars in this genus are popular bedding plants. Although perennial, they are usually raised from seeds as annuals. Sow seeds (see p. 151)

at 59°F (15°C) in light to germinate in ten days for flowers in the same season

Perennials, especially the recent selections such as Surfinias for which seeds are not available may be increased from softwood stem-tip cuttings (s. c p 154). Overwinter new plants under cover if necessary

# PHLOX



Philox panicinata Graf Zeppelin

DIVISION in spring or in early
SEEDS in early spring 1
CUTTINGS in early spring
late spring or in assumo 1

Division and basal stem cuttings from perennials in this genus produce flowering plants in the

same year. Aerial parts of phlox are prone to hematode infestation, which is often not easily detectable, so herbaceous border kinds in particular should be increased from root cuttings. Seeds do not usually transmit nematode infestations, either (For annuals, see p. 228.)

#### **DAVISION**

Divide only healthy herbaceous phlox in spring (see p. 148), alpines in early autumn. Mai-forming alpines do not respond well to division. Single bud divisions (see p. 150) are also possible.

#### SEEDS

Sow seeds of species (see p.151) at 59°F (15°C) to germinate in 7–10 days, Shade seedlings of wood and species. Plants flower in the second year

#### CUTTINGS

Alpines that have suitable shoots, and woodland species, may be increased from basal stem cuttings in early spring (see p 156). They will root at 59°F (15°C)

Alternatively, take softwood stem-tip cuttings in late spring, this is a good way of increasing mat forming alpines Cuttings of smaller alpine species (see p 166) may be only lin (2.5cm) long, root them in a mixture of equal parts sharp sand and stertazed soil

In autumn, lift border phlox and take Ln (2.5cm) cuttings (see p 158) from thicker roots, place horizontally in travs.

# PRIMULA PRIMROSE



A huge and varied

short-lived perennials

Division in early spring or

SEEDS in midspring 11 or in

late summer to autumn 1

CUTTINGS in winder !!

eld the state of the

which are increased in a variety of ways

#### DIVISION

Permata

Regular division keeps cultivars of P vulgaris and Polyanthus primroses healthy but can weaken other species Pull apart fibrous-rooted clumps into single, rooted crowns or rosettes. Divide species with woody rootstocks such as Primula altionn with a knife (see p. 148) Pot alpines, or replant larger divisions

to grow on. Cut back by half the largeleaved types, such as bog primroses and candelabras, to reduce moisture loss

#### SEDS

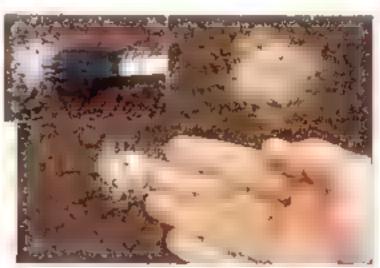
All species may be raised from seeds (see p 164). Seed-raised primroses have the advantage of being virus-free, but some garden species, especially P elation P veris, P vulgaris, and candelabra types hybridize readily unless isolated. In general, seeds are set only if both pincyed (long style, short stamens) and thrum-eyed (short style, long stamens) plants of the species are grown

The seeds are short-lived so are best sown fresh, but seeds may be sown in spring at 59°F (15°C). For most primroses, a moist, organic-rich, yet free-draining soil mix is ideal.

#### SCOOPING ALPINE PRIMROSES



I select vigorous plants there of Primula densiculated just as they start into growth Use a sharp bride to cut or scoop out the crown of each plant and expose the top of the mots



2 Use a face brush to dust the cut more was fungicide (see suset) to guard against not Cover each champ of scooped roots with a shallow layer of sharp sand

# PULSATILLA PASQUE FLOWER

SEEDS as soon as ripe or in autumn I CUTINGS from spring to a tomn or in winter 111

These plants are slow to propagate by vegetative means but are easy to raise from seeds. Once established they should not be disturbed, division and root cuttings are both challenging but worthwhile methods of increasing rare or unusually fine forms, especially of alpines. Seeds give excellent results if they are sown fresh

#### SEEDS

Sow seeds (see p 164) from the feathery seedheads the moment they are ripe. The plumes tend to push the seeds out of the soil mix as they germinate: trim off the plumes before sowing or gently push the seeds back down. Seeds of P halieri and P vulgaris germinate in 10–14 days, and the seedlings flower in the following year. Other species may not germinate until the following spring, whenever seeds are sown. Do not allow seedlings to become potbound.

#### CUTTINGS

Lift and divide (see p 167) strong, multicrowned plants into individual shoots, or rooted pieces, in spring after flowering, or in autumn. Each shoot should have a 2-3in (5-8cm) stem and a few roots, if possible. Pot in equal parts of sharp sand and peat, making sure that the bud is just above the surface of the soil mix. Place in a semi-shaded cold frame, keep moist, not wet. Provide more light when new growth is visible

In winter, take root cuttings (see p 167) from a vigorous, multicrowned plant. Remove only the thickest, healthy roots and discard the parent, which will not recover. Cut the roots into 1/-2in (3-5cm) lengths. Insert in a gritty soil mix so that the upper ends are just level with the surface. Keep moist but not wet. Pot after shoots appear

Material for cuttings can be obtained without disturbing a container-grown parent plant by allowing it to root into a sand bed, as for Eryngium (see p.196)

Germination is most successful if the seeds are exposed to light (cover them only lightly with vermiculite, not soil mix) and kept moist and not too warm

#### CETTINGS

Root cuttings (see p.167) can be used to propagate color forms of P denticulata, cut thicker roots of the parent plant into 1 /= 2 in (4-5cm) pieces. Take rosette or single leaf cuttings of Petiolaris primroses as for Ramonda (see below)

#### SCOOPING

Scooping, either in open ground (see below) or in pots, is useful for alpines such as P denticulata and leafy primroses which produce a leafy tuft at soil level freat the removed topgrowths as rosetic cuttings (see p 166)



3 When the new shoots are 1 201 (2.3-5cm) tall, lift each plant. Take care not to domage its roots. Plat it apart gently into single resertes each with strong roots. Deat as reserte cartings

# RANUNCULUS BUTTERCUP, CROWFOOT

Owision in autumn or in spring !
SEEDS in spring or from sommer to autumn 111

Most perennials in this large genus are quite hardy; Ranunculus asiaticus is much less so. Buttercups increase naturally from seeds, division is often quicker (For aquatic species, see p. 168.)

#### DIVISION

Divide herbaceous plants after flowering most alpine species in spring Separate each plant into single, rooted crowns (see p. 148). Pot alpine divisions, replant or line out in a nursery bed herbaceous border kinds, such as R. acontifolius

#### SEEDS

Sow seeds of R astaticus in early spring at a temperature of 59°F (15°C). The seedlings may flower in the first summer before they die down for the winter

In most other species, seed dormancy must be broken. When the seeds are ripe in summer or autumn, they quickly fall away, often while still green. They are best gathered just before this point, immediately sown in pots, and then exposed to winter cold (see pp.151-2). Use a gritty, soil-based seed mix.

Place in a sheltered place such as a cold frame. Fresh seeds often germinate in the following spring but older (black or brown) seeds, and seeds of some Australasian species, take two or more years to germinate.

# SAINTPAULIA AFRICAN VIOLET

DIVISION in spring 1



SEEDS in spring 11 CUTTINGS in spring or at any time when plants are in growth 1

The easiest way to raise African violets is by leaf cuttings. Division may be used for any of these

tender perenmals, some specialized flower-color patterns (chimeras) are propagated from flower-stalk plantlets.

#### DIVISION

Saintpapilia

Bright Lycs

Carefully tease apart rosettes, making sure each has roots (see p 167). Pot and tent in plastic bags for three weeks in a shaded, warm place until established

#### SEEDS

Sow seeds on a layer of moss spread over seed soil mix (see p 165). At 70°F (21°C) germination occurs in 2–3 weeks. Seedlings develop slowly, when large enough to handle, pot singly. Once established, grow them at 59°F (15°C)

#### CUTTINGS

Take fully developed new leaves with their stalks (peubles) as cuttings. Insert in pots, either singly or several around the edge (see p.157). Roots will be produced after a month and plantlets a month later. Detach the plantlets from each petible and pot individually when they are large enough to handle.

# RAMONDA

DIVISION in early situmer 44 SEEDS in early or midsuminer 444 CUTTINGS in scinmer or early automo 444

These evergreen perennials rot if exposed to winter moisture. Divide congested plants carefully with a sharp knite into individual, rooted rosettes (see p. 167), pot and grow on before planting.

Ramonaa set abundant, dustlike seeds, which are easily lost once the small seed capsules ripen. Sow the seeds thinly (see p. 164) as soon as ripe on organic, moist soil mix. Leave seedlings undisturbed for the first winter and transplant when large enough to handle in the spring.

Small rosette cuttings, or even single leaves, may be severed (see p 166) retaining as much stem as possible – at least %in (1cm). Insert them in gritty soil mix or in equal parts of sharp sand and peat in a shaded propagating frame outdoors. They are slow to root. Plants may bloom in the following year but will flower more freely after 18 months.

#### OTHER PERENNIALS

Pittowns Divide in spring (see p. 148) 4.
Seeds (p. 151) in spring at 59°E (15°C) 4.
Pitownical Divide in spring (see p. 148) pot rad (p. 30°C) 4.
Seeds (p. 151) in spring at 64°F (18°C) 4.
Pitrost is Divide in spring (see p. 148) 4. Sow caned seeds (p. 151) in spring at 59°I (15°C) 4.

Precincentus Sow seeds (see p.151) in spring at 70°F (21°C) §. Semi-inpe cuttings in late summer as for Solenostenion (p.209) §. Potential via Divide (see p.149) in spring §. Sow seeds (pp.151–2) in autumn §. Potential via Divide in early spring (see p.148) §§ Sow seeds (p.151) in spring

at 50°F (10°C) | POLYGONATEM Divide in spring (see p 149) | Sow seeds (p 151) in autumn, keep in a cold frame germination may be slow

and erratic II.

Potentilla (syn. Comarum) Divide herbaceous plants (see p.148) in spring §. Sow seeds (p.151) when ripe in spring keep in a cold frame §.

PRUSELIA As for Polemonann I
PULBONAR A Divide after flowering or in
spring up 149 I. Seeds up 151) in spring at
50°F (10°C) I. Take root cuttings in winter I
RAUULIA Divide mat in spring or early
summer (see p 167) II Sow seeds up 164)
thirdly in rich, griffy soil mix in spring II
Softwood cuttings (p 166) in summer of
new 3-766 (1-2cm) shoots, rooting erratic I
RAIL M Divide in late winter as Paconia (see
p 264) I. Sow seeds (p 151) at 50°F (10°C)
in autumn I. (For vegetable, see p 366)

RODGERSIA Divide in spring (see

p. 149) L. Sow seeds in spring on

moss as for Surracenta

(p 208) at 50°F

(10°C) I

RUDBECKIA Divide in

spring (see p.149) I. Sow seeds
(p 151) in spring at 50°F

(10°C) I. Basa, stem cultings
(p 156) in spring I. (Fa)

annuals, see p 228.)

RUDBECKIA FULGIDA VAR SPECIOSA VIETTE'S LITTLE SUZY

# SALVIA SAGE



DIVISION IN Spring | SEEDS in spring [ BASAL STEM CUTTINGS IN late STEM-TIP CUTTINGS IN Late summer or to early automn 1

Satisfic splendens Cleopatra Series

Perenntal species from this large genus of quite hardy to very tender

plants may be raised from seeds Divide border perennials such as Salvia nemorosa and S. x superba. Take basal stem base of the flower spike and shed their cuttings from border plants, for example

5. guaranitica (syn. \$. concolor). For annuals, see p. 228; for the culmary sage, S. officinalis, see p.291

#### DIVISION

To divide established plants (see p. 148), cut the woody rootstock into 2-4 pieces with a knife and replant

#### SEEDS

Seed pods ripen successively from the seeds within two days; gather ripe pods frequently. Sow seeds (see p 151) at 61-64°F (16-18°C). Protect seedlings from cold, if necessary

#### CUTTINGS

Take basal stem cuttings (see p. 156) from new shoots that are about 3m (8cm) tall Root at 59°F (15°C) to flower in the same season. Take soft and semi-ripe stem-tip cuttings (see p. 154) from new, nonflowering growth. Pot. rooted cuttings and keep frost-free over winter Plant out in late spring

# SANSEVIERIA SNAKE PLANT

DIVISION in early spring 1 **GUTTINGS** at any time \$1

Of these tender plants, only Sansevieria trifasciata and its forms are commonly grown in temperate areas. Variegated cultivars can be propagated only by division to perpetuate the leafpatterning (cutting-raised plants have unvariegated leaves)

#### DIVIS ON

Divide large clumps with a spade or sharp knife when plants are dormant or about to start into growth (see p 148) This may be almost any time, but early spring is preferable. Pot into small pois, keep as warm as possible, and water sparingly until plants establish

#### CUTTINGS

Prepare leaf cuttings (see right and p 157) from newly mature, healthy leaves. Cut each leaf horizontally into pieces, then insert these in pots or trays of sandy rooting medium. It does not matter if cuttings in any row touch Place in bright, indirect light at about 70°C (21°C); leave uncovered and keep the medium just moist. If the cuttings are basal end down in the compost, new roots and shoots should develop from the bases in 6-8 weeks



Prepare a tray with a nex of equal parts peat and sand. Cut newly mature leaves here of Sansevieria trifasciata) into 2 n 5cm) sections (see left). Insert the cuttings, lower edge downward in the medium in rows. Space the rows 2in (5cm) apart

# SARRACENIA PITCHER PLANT

DIVISION in spring | Secos in spring 11

Sarracenia purpurea is quite hardy; other species are much less so. Do not let divisions or seedlings dry out

#### DIVISION

Divide large clumps just before new growth begins (see p. 148). Cut off rooted crowns with a sharp knife, pot in live

sphagnum moss (if possible) and keep moist at a temperature of 59°F (15°C)

#### SEEDS

Seeds germinate well if fresh, moist, and exposed to light - old seeds germinate erratically, if at all. Cold stratification (see p.152) improves results from old seeds For a reliably moist environment that minutes the natural habitat of these bog

plants, surface-sow seeds on moss (see below) Keep the seeds moist by sinking the pot in a larger one of moss, kept permanently damp, or cover with a sheet of glass or plastic, water from below, and ventilate regularly. Rainwater is best since it is lime-free Germination takes 2-3 weeks at 61°F (16°C). When large enough to handle, pot seedlings singly in sphagnum moss or soil mix

#### SOWING PITCHER PLANT SEEDS ON MOSS



T Fill a 3min (9cm) pot with soitless seed mix L to within 1/sin (2cm) of the rim and firm. Rub some moist sphagnum moss through a fine-mesh sieve to give it a fine texture



Atil weeds seeds in the moss by soaking it in boiling water When it is cool, squeeze out the excess water. Add a sin (5mm) layer of this moss to the pot of soil mix



Plunge the prepared pot into a larger one Itlled with moist spliagrium moss. Sow the seeds thinly over the surface of the inner pot Place in humid, bright shade at 61% (16%)

# SAXIFRAGA SAXIFRAGE



Saxiyraga

DIVISION in spring or autumn !
SEEDS in autumn or spring !
CUTTINGS in late spring ! or !!
BULBILS in early summer !

Division is the easiest way to increase these plants, except for the cushion plants. Mator cushion-forming

types may be grown from cuttings. species from seeds.

#### DIVISION

Carefully tease apart (see p. 148) fibrousrooted clumps such as Saxifraga fortuner
(syn. S. cortusifolia var fortuner) in midspring before growth begins, for flowers
in the same year Pull off rooted rosettes
or offsets of species such as S. x urbium
and S. paniculata (syn. S. atzoon) after
flowering, grow on in pots or nursery
beds. Stems of S. stolonifera can be
encouraged to form plantlets (see p. 150)

#### SEEDS

Sow fresh seeds in pots, covered lightly with grit. Those sown in autumn and exposed to winter chill in a cold frame (see p. 152 and p. 164) germinate more evenly Spring-sown seeds germinate in 2–3 weeks. Plants flower in 2–3 years

#### CUTTINGS

Treat rosettes without roots as cuttings (see p. 166), remove with /=-lin (1-2cm) of stem, root at 59°F (15°C) in gritty soil mix for flowers the next year Cuttings from alpines may be tiny; root them in pure sand or pumice (see p. 167).

#### BUTBLES

5. granulata produces bulbils in leaf axils (see p.26) as it dies down in summer Store in moist sand and "sow" in early spring in trays in seed soil mix at 50°F (10°C). Plant out in the following year.

# **SHORTIA**

DMSKON in late spring 11
SEEDS when ripe or in early spring 11
BASAL STEM CUTTINGS in early summer 111
STEM-TIP CUTTINGS in late summer 111

These alpines (syn Schizocodon) are set back by disturbance, develop slowly, and are very vulnerable to drying out. Divide after flowering (see p. 148). If available, sow seeds (see p. 164) at 50°F (10°C) in nch, acidic to neutral soil mix, do not disturb seedlings in the first year.

Take basal stem cuttings or stemtip cuttings (see p. 166) from strong. 1½–24nn (4–6cm) shoots; insert in pois in equal parts of sharp sand and organic soil mix. Rooting of cuttings is slow and not always successful

# SISYRINCHIUM

Division in spring or in early autumn \( \)
SEEOS from summer to autumn or in spring \( \)

Divide perennials in this genus, especially variegated forms, ensuring each leaf-fan has roots (see p. 149). Many self-sow prohitically. Sow seeds (see p. 151 and p. 164) as soon as they are ripe or in spring at 59°F (15°C)

# SMITHIANTHA TEMPLE BELLS

DIVISION in late wanter |
SEEDS in spring |

The rhizomes of these tender plants increase readily, divisions (see p. 149) flower within a year. If stock is scarce, cut the rhizomes in half

Sow the seeds on a layer of fine sphagnum moss over seed soil mix as for Sarracenia (see Jacing page) at 70°F (21°C). Germination takes 10–14 days but the seedlings grow slowly. Lower the temperature to 64°F (18°C) when the seedlings are established.

# SOLENOSTEMON COLEUS, FLAME NETTLE, PAINTED NETTLE

SEEDS from early spring to early summer & CUTTINGS from early spring to late summer &

Of these tender plants, cultivars and hybrids of \$ scutellartoides (syn. Coleus blumet) are the most popular and widely grown

#### SLIDS

seeds see p 15) provide an easy way to raise hybrids. Most come fairly true some have pleasing variations, discard poor seedlings. Surface-sow seeds and keep moist, at 64°F (18°C), in good light to germinate in 10–14 days. Grow on established seedlings at a minimum temperature of 59°F (15°C)

#### CUTTINGS

Take softwood stem-tip cuttings (see p.154) from named cultivars. They toot reachly in a free-draining medium such as rockwool, or even in water on a bright, warm windowsill (see p.156). They root in 10-14 days at 64°F (18°C).

#### OTHER PERENNIALS

SANGUISORBA Divide in spring (see p 149) L. Sow seeds (p.151) in autumn, keep cool in cold frame, germination may be errain: 👪 SAPONAMA Divide in spring (see p 148) 1 Seeds (p.151) in spring at 50°f (10°C) ‡ Soft stem-tip cuttings (p.154) in spring 1 Scanosa. Divide in midspring (see p. 148) 1. Seeds (p.151) in spring at 59°F (15°C) } Basal stem cuttings (p.156) in late spring & Schizostylis. Divide in spring (see p. 148) 1. Seeds (p.151) in spring at 59°F (15°C) 1 Scropneragia Divide in spring, especially variegated plants (see p. 148) \$. Sow seeds (p 151) in spring at 50°F (10°C) ↓ Take basal stem cuttings (p. 156) in spring \$ Scutellaria Divide in spring (see p 148) 1 Sow seeds (p 151) in spring at 50°F (10°C) or as soon as ripe & Take softwood cuttings in late spring or basal stem cuttings in spring (pp. 154-6) 1 SELACINELLA Divide carefully in spring (see p 149) 1. Sow spores as for ferns (p. 159) 1. Take stem-tip cuttings in spring (p.154), they root quickly in organic, moist soil mix at 70°F (21°C) 1. SEMIAQUILEGIA As for Aquilegia (see p 189) L Senecio As for Schrzostylis & MUALCEA Divide in spring (see p. 148) 1 5ow seeds (p 151) in spring at 50°F (10°C) 1. Take basal stem cuttings (p 156) in spring 1 SILENE Divide

STRELITZIA REGINAE

(see p. 148)

after flowering 11. Sow seeds (p 151) as soon as ripe or at 50°F (10°C) in spring 4. Take basal stem cuttings in spring (p.156), 8m. (1cm) long of alpines | SMILACINA Divide after flowering (see p 148) L Sow seeds (p 151) in autumn and expose to cold, germinates slowly 👪 SOLDANELLA Divide (see p. [48]) regularly. after flowering to keep vigorous 4. Sow seeds (p. 151) as soon as ripe in moist, organic soil mix keep in a cold frame 11 Soremoux (syn. Hebane). Divide in late. spring (see p. 148) | SOLIDAGO: As for Scabiesa L x Solidaster luteus (syn x 5 bybridio). Divide in late winter (p 148) 1. SPATHYPHYLLOM Divide in spring (see p 149) L. Sow seeds (p 151) as soon as available at 75°F (24°C) II SPHAFRALCEA (syn Itiamina) Sow seeds (see p 151) in spring at 59°F (15°C) L. Take basal stem cuttings (p.156) in spring 1. STACHYS (5ym. Belonica) Divide in spring (see p. 148) Single bud divisions are possible (p 150) 1. Sow seeds (p 151) in spring at 59°F (15°C) L

STOKESIA CAPVIS Divide in midspring (see p 148) 1.
Sow seeds (p 151) in autumn or spring at 59°F (15°C) 1.
Take root cuttings (p.158) in late wanter 11.
STRELITZIA Detach rooted suckers carefully after flowering, as for Musa (see p 204) 1. Sow seeds (p 151) in spring at 70°F (21°C) 11.

# STREPTOCARPUS CAPE PRIMROSE



Streptocarpus

Onvision in spring I SEEDS in spring II CUTTINGS from spring to patomn I

Some of the tender perennials in this genus are monocarpic. The multiple-leaved species and cultivars may be

divided or grown from leaf cuttings Seeds are useful for raising new hybrids and especially species that produce only a single leaf, such as Streptocarpus grandis. A few species, for example S. saxorum, have stems, the tips of which can be taken as cuttings

#### DIVISION

Cut or pull established clumps apart (see p 148) Pot each rooted crown singly Kept at 15°C (59°F), they root well in three weeks and flower in the same year

#### SEEDS

Sow seeds on a layer of fine moss as for Sarracenia (see p 208) at a temperature of 70°F (21°C). Seedlings will appear in 10–14 days but develop slowly at first Flowers will appear in the second year and often in the first

#### CUTTINGS

Take stem-tip cuttings from healthy plants (see p.154) at any time when they are in growth. Kept at 59°F (15°C), the cuttings should root in 2-3 weeks. New plants will flower in the same season

Io take leaf cuttings, cut a mature leaf in half along the midrib (see p 157) or for a greater number of plants, into smaller sections (see below). Insert each section vertically, cut or basal edge down, into a deep tray of rooting medium at 64°F (18°C). Plantlets appear along the cut veins in about four weeks; when they are well developed, detach them and pot singly to grow on.



LEAF CLITINGS OF CAPE PRIMROSE

Lat a leaf into chevious or transverse sections at least 1 in (2.5cm) deep. Stand the ctiologs, basar end downward, in rows in a tray of rooting medium. Lightly from, label, and water

# **TRADESCANTIA**



71 (12.4).

DIVISION IN Spring & SEEDS IN Spring & CUTTINGS at any time &

The hardier species respond well to being divided. Tender types are more often propagated from cuttings. All species

may be raised from seeds, although variegated forms do not come true

#### DIVISION

In cold chimates, divide (see p. 148) hardy border kinds only. Pull apart the compact, fleshy crowns carefully. Roots may be fibrous or tuberous.

#### SEEDS

Sow seeds (see p 151) and keep at 59°F (15°C), or 64°F (18°C) for tender species. Seedlings should appear in as little as seven days. Plants flower in their first or second season

#### CUTTINGS

Stem cuttings (see pp 154-6) of creeping forms, for example the variegated Tradescantia fluminensis, root easily, even in jars of water on a windowsill, if they are taken from plants in active growth Alternatively, insert four cuttings around the edge of a pot in rooting medium. In two weeks, they may be potted on as one plant.

# THALICTRUM MEADOW RUE



Tharateum mategnfolium

Ordsion in midspring a Seeds as soon as tipe of in early spring 44

The majority of the rhizomatous perennials in this genus are quite hardy, although a few are less so. The popular cultivar 'Hewitts

Double is sterile and can be increased only by division. Divide the rhizomes carefully as growth begins (see p.149). Divisions can be slow to re-establish and may not flower until the second year. Sometimes rhizomes with some roots and buds at the edges of a clump may be detached without necessarily lifting the parent. Pot and grow on in part shade until established.

Gather seeds just before they ripen and turn brown, once ripe, they are rapidly dispersed. They are best sown fresh: older seeds germinate erratically because of embryo dormancy (see p.152). Sow the seeds (see p.151) in a sheltered place such as a cold frame. Seed-raised plants take 2–3 years to reach flowering size.

# TOLMIEA PIGGYBACK PLANT

DIVISION in spring !
PLANTLETS at any time !

Tolmica mengiesii is the only species
Mature plants can easily be divided in
spring (see p 148). An alternative is to
exploit the natural process by which
new plantlets form on the leaves, at the
point where the blade (lamina) and stalk

(petiole) meet – hence the common name. Detach a leaf with plantlet when the plant is in active growth and pot (see below) or, in open ground, weigh the leaves onto the soil with stones. After a few months, sever the leaf stalks to detach rooted plantlets as for rooted runners (see p 150).

#### PROPAGATING PIGGYBACK PLANTLETS



I Snip off a healthy leaf (here of Tolmica meritiesis Taff's Gold') with a plantler at the top of the leaf stalk (petiole). Retain & Im (1-2.5cm) of the petiole. Fill a 3m (8cm) pot with a mix of equal parts peat and sand



2 Fold down the leaf around the base of the plantlet to meet the petiole Bury the leaf and petiole so that the plantlet sits just on the surface (see inset) and firm. Water and leave in a light, warm place to root (usually 2-4 weeks)

# TRICYRTIS TOAD LILY

DIVISION in early spring [
SEEDS in autumn []
CUTTINGS from mid- to late summer []

These plants have rhizomes or creeping, rooting stems (stolons). The tough clumps of rhizomes can be lifted and cut apart when dormant (see p 149), or rooted stolons may be lifted and

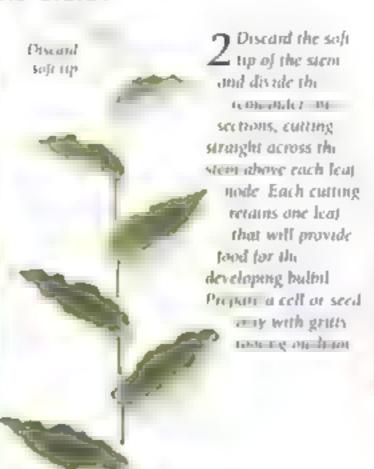
detached Plants may flower in the same year. All species can be raised from seeds. These ripen late in the growing season so are not always available in cold climates. Seeds should be sown immediately and exposed to winter cold (see p.152); germination may be delayed. Expect flowers in three years.

One plant may furnish several stems for leaf-bud cuttings (see p 154 and below), inserted into a gritty rooting medium. In humid conditions, a bulbil the size of a wheat grain will form in the leaf axil of each cutting before winter, and the leaf will die. In spring, new plants emerge Pot or plant out to flower in two years.

#### TAKING STEM CUTTINGS OF TOAD LILIES



I load lines occasionally produce tiny bulbils in the leaf axils, often forming plantlets (see uset). To exploit this, take stein entings in carry stommer just as flower bads are beginning to form and the stepis there of T. hirta) soften Remove a long healthy northowering stem





3 the surface and do not touch. Place in a humid, shaded place with gentle bottom heat



The leaves will die divdy as the cuttings root and hidbids form. New shoots may form before the cuttings become dormant over whiteitsee misel? Keep them just moist until spring

# TRILLIUM

DIVISION after flowering 1 SEEOS when ripe or in winter 111 SCORING after Dowering 11

Divide thizomes into pieces (see p.149), each with at least one bild and some roots. They may reestablish slowly. Slice rhizomes of robust species into 1%—2in (3—5cm) lengths or score them in situ (see below), side-buds form which may be removed after a year and potted. Sow seeds in pots (see p.151) and expose to winter cold. Germination is slow; plants take five years to flower.



Scoring Trilliam relizomes

Score around the exposed rhizome just below
the growing point. Dust the cut with fungicide
cover, and teave for a year. Lift the rhizome and
actach and pot the offsets (see inset) single.

#### OTHER PERENNIALS

STROMEANTHES Divide in spring (see p 148) I Seeds (p 151) in spring at 59°F (15°C) I Take basal stem or soft stem-tip cuttings pp 154 and 156) in spring I STROMANTHE Divide in spring (see p 149) I Seeds (p 151) in spring at 70°F (21°C) I STYLOPHORUM Divide after flowering (see p 148) I. Sow seeds (p 151) in spring at 59°I or (-1

Intermedia

SIMPHIANDRA Sow seeds (see p 151) in winter and early spring at 59°F (15°C) 4 SYMPHYTUM Divide (see p 148) in spring only way to increase variegated forms 1 Seeds (p.151) in spring at 50°F (10°C) [ Take root cuttings (p 158) in winter 1. TACCA Divide rhizomes in spring (see p 149) or when plants start into growth & Surfacesow seeds (p.151) in spring at 77°F (25°C) [ TANACETCM (5vn Balsannta Pyrethrion) Divide in spring (see p. 148) 1. Sow seeds (p 151) in spring at 50°F (10°C) 1 Take basal siem cuttings in spring [ TELLIMA GRANDIFLOHA Divide in spring (see p. 148) 1. Sow seeds (p. 151) as soon as ripe 1. TETRANEMA Divide in spring (see p.148) 1. Sow seeds (p.151) as soon as ripe or in spring at 64-70°F (18-21°C) 1 THERMOPSIS Divide (see p. 149) in spring or

autumn II. Soak seeds for 24 hours in coldwater, then sow (see p 151) in spring at 59°t (15°C), germination often poor III. Theory Sow seeds (p 151) when ripe or in early spring in pots, keep in a cold frame I. Soft stem-tip cuttings (p 154) in spring I. The NBERGIA Sow seeds (see p 151) in spring at 70°F (21°C) I. Take semi-ripe cultings (p 154) in early autumn I. Itarella. Divide in spring (see p 149) I. Sow seeds (p 151) in autumn, keep in a cold frame I.

TOWNSENDIA Sow seeds (see p. 164) as soon as ripe in pots in gritty soil mix, keep in a cold frame J. Take rosette cuttings (p. 166) in spring with as much stem as possible !!!. Often short-lived, propagate regularly TRACHELIUM (syn. Diosphacra) Sow seeds (see p. 164) of T caeruleum and alpines in spring at 50°F (10°C) 1. Take softwood cuttings (p. 154) in spring 11 THIFOLIUM Divide (see p. 148) or detach rooted stems in spring 1. Sow seeds in spring at 50°F (10°C) after soaking in cold water lor 24 hours (pp 151-2) & TROLLIUS Divide after flowering (see p 148) Sow seeds (p 151) as soon as ripe or in spring, may take two years to germinate 11

# TROPAFOLUM



fropaeolum speciosam

Division in spring \$1
SEEDS in autumn 1 to 111
LAYERING in late winter or inearly spring 1

The most widely grown herbaceous perennial in this genus is the llame nasturnum (Tropaeolum speciosum)

For annuals see p 229; for tuberousrooted species see p.278

#### DIVISION

Divide rhizomes before new growth begins (see p. 149); pull them apart and curl long sections into pots. Small pieces may be treated as root cuttings (see p. 158). Most Tropaeotum resent root disturbance, and success is variable.

#### SEEDS

Seeds of perennials have short viability, and germination is often erratic. Sow (see p 151) as soon as ripe, one seed to a pot to avoid root disturbance. If needed store seeds in moist peat. Soaking older seeds in cold water for 12–24 hours may improve germination. Keep in a cold frame. Seed-raised plants may take 3–5 years to bloom.

#### LAYERING

Simple layer (see p 106) long shoots, covering them with 1 in (2 5cm) of soil

# UNCINIA HOOK SEDGE

DIVISION IN Spring & SEEDS IN AUGUSTS OF IN APPEND &

These perennials form clumps sometimes rhizomatous that can be carefully divided (see pp. 148-9). Seeds have short viability; sow them (see p. 152) still in their husks as soon as they are ripe at a minimum of 59°F (15°C). Plant out the seedlings in the following spring, in cold climates, make sure this is after any risk of late frosts has passed.

# VERATRUM



Veruerum udhani

Division in early spring or in autumn 11 SEEDS in autumn 111

Divide rhizomes (see p 149) of these plants with care, all parts are toxic, and the sap may irritate skin. Sow the seeds (see p.151) as

soon as they are ripe, then expose to winter cold. The seedlings may take several years to emerge will develop slowly and take years to flower.

# VERBASCUM MULLEIN

DIVISION IN Spring | SEEOS in Spring | CUTTINGS in late autumn |

Perennials in this genus (syn. Celsia) that form substantial clumps, such as Verbascum nigrum, can be divided Cultivars will not come true to type from seeds, but the resulting seedlings may include attractive plants. Short-lived perennials such as V 'Helen Johnson' do not form large clumps; root cuttings offer an alternative to division (For annuals and biennials, see p 229)

#### DIVISION

Divide clumps (see p. 148) before they start into growth, to flower that year

#### SEEDS

Sow seeds at 59°F (15°C) to germinate in 10–14 days. Seedlings usually flower in the second year. Some Verbascum self-sow freely in the open garden.

#### CUTTINGS

Lift a plant and take 2in (5cm) root cuttings from healthy, thicker roots (see



VERBASCUM 'GAINSBOROUGH

Resette-Jordang percentals with as the scale war as an all produce its research liber oray be carefully detached and replanted without the need to disturb the parent plant.

p 158) Place horizontally in a tray of soil mix and pot when rooted in spring Discard the parent. Container-grown plants may be rooted into a sandbed as for Eryngium (see p.196). Rooted cuttings flower in the following year.

# VERBENA VERVAIN



Ve bend Steanghurst

Division in spring ( Secos in spring ( Cuttings in late summer (

Most of the species and cultivars in this genus are grown as bedding from seeds, such as Verbena x hybrida cultivars. Bedding

Verbena and many other species can be increased by cuttings. Divide fibrous-rooted plants, for example V corymbosa and V. Homestead Purple

#### DIVISION

Divide mature clumps (see p 148) for flowers in the same year. Prostrate stems may root where they touch the soil, the plantlets may be detached, potted, and grown on (see p 150).

#### SEEDS

Sow seeds (see p 151 at 10 ± 12. C)
Germination takes 14 days, and
seedlings flower in the same year
V bonariensis (syn. V patagonica)
often self-seeds

#### CUTTINGS

Take semi-npe stem-tip cuttings (see p. 154), from nonflowering growth if possible. At 59°F (15°C), cuttings root within 14 days. Keep the cuttings in bright light and overwinter with cold protection, where necessary.

# VERONICA SPEEDWELL

ONISON in early spring or in autumn 1
SEEOS in spring 1
CUTTINGS in late spring 1

Most of the herbaceous perennials in this genus are quite hardy. Protect those with woolly leaves, such as Veronica bombycina, from winter moisture. Many have a spreading habit, often rooting from stems, so they respond well to division. All species may be raised from seeds. Take basal stem cuttings from species that flower in summer, such as V. longifolia.

#### DIVISION

Divide small, mat-forming species such as V. spicata (see p. 166) in spring, or detach rooted portions for flowers in the same year. Divide (see p. 148) early-flowering species (V. gentianoides) after flowering to bloom next year. Clumps may be divided into single buds (see p. 150)

#### SEEDS

Sow seeds (see p.151) at a temperature of 59°F (15°C) and cover very lightly to allow some light to reach the seeds Cultivars will not breed true to type

#### CUTTINGS

Take basal stem cuttings (see p 156) when new shoots are 3m (8cm) tall at 59°F (15°C), they root in two weeks. Take stem cuttings from tall-stemmed plants (see p.156) Rooted cuttings may flower in the same season

# VIOLA PANSY, VIOLET, VIOLA



Division in early spring or in autumn or late winter \$ SEEDS in spring or in midsuminer \$ CUTTINGS from late spring to late summer or in autumn \$ MOUNDING in summer \$

Viola Tricolez

Perennials in this genus are sometimes

short-lived but most of them are fairly easy to propagate

#### DIVISION

Divide (see p. 148) clumps of V. odorata after flowering in early spring. Pull apart Viola cultivars into 2-4 pieces. Matforming species such as V. rivintana are easily divided, they flower the same year if split in autumn or late winter.

#### SEEDS

Sow seeds (see p. 151) of most species in early to midspring and keep at 59°l (15°C). Sow winter-flowering pansies in midsummer. Seedlings should appear in

10–14 days, transplant when large enough to handle. Stemless alpines such as V joot are best left in the seed pans until the following spring, then carefully transplanted. Some species self-sow and hybridize freely. Many violets set viable seeds from insignificant (cleistogamic) greenish flowers, which never open

#### CLTTINGS

Named cultivars may be sterile but root well from 1-2in (2.5-5cm) stem-tip cuttings. During flowering, stems of pansy and viola cultivars elongate and become hollow and stem cuttings will not root, so take cuttings in spring from new shoots. Insert them in equal parts of sharp sand and soil at 59°F (15°C) they will root within 14 days. Pot once they show renewed leaf growth

Alternatively, three weeks before taking cuttings in autumn, cut back plants and take stem-tip cuttings from the regrowth. Keep rooted cuttings frost-free with good light over winter.

#### MOUNDING

Species may also be top-dressed with gritty soil mix, or mounded (see below), to encourage the stems to root. These rooted stems may then be detached, potted and grown on as for cuttings.



Mot Noing a CLI MP OF VIOLA

Work in a mix of equal parts fine grit and peut

or exer the bottom half of the shoots in a

oretta have very viola communa) Keep

moist for 5-6 weeks until the shoots root into the
soil mix. Detach the shoots and pot to grow on

# WAHLENBERGIA

Division in spring & SEEDS in early spring or in late summer & CUTTINGS in spring or in early summer &

Often short-lived, perennials in this genus must be regularly propagated Mat-forming plants may be divided (see p.167), and rooted suckers may be detached from W. gloriosa. Sow the tiny

seeds when ripe or in early spring (see p 164) at 59°F (15°C). Take basal stem cuttings from strong new shoots (see p 166); root in a free-draining soil thix in a sheltered place such as a cold frame take soft stem-tip cuttings (see p 166) in summer and root at 59-64°F (15-18°C). Most new plants flower in the first year

# ZAUSCHNERIA CALIFORNIA FUCHSIA

Division in spring 11
SEEDS in spring 1
CUTTINGS in late spring 1

Divide (see p 148) these plants with great care. Sow seeds (see p.151) at a temperature of 59°F (15°C) bottom heat improves germination. Take softwood stem-tip or basal stem cuttings (see pp 154 and 156). New plants flower in the first season.

# ZANTEDESCHIA CALLA LILY

DIMISION in apring \$ SEEDS in apring \$\$

Zantedeschia aethiopica and its cultivars are slightly cold-tolerant, but most species are tender. They form large clumps of tuberous rhizomes, which are easily divided. Of the cultivars Z. aethiopica 'Green Goddess' is the only one that comes true from seeds.

#### DIVISION

In cold climates, dormant rhizomes of all species can be boxed up in trays of moist sand in a temperature of 59°F (15°C) until the buds begin to swell. When these are visible, cut the rhizomes into pieces, each with at least one bud. Dust the cut surfaces with fungicide. Replace the rhizomes in the sand at the same temperature to root, when they can be potted or planted.

Large clumps of Z. aethiopica and of other species and cultivars overwintered in situ in warm climates may also be lifted and split just as growth begins (see p.148). Divisons flower in the same year

#### SEEDS

Sow one seed to a 3in (8cm) pot (see p 152) and keep moist at 70°F (21°C) to germinate in a few weeks. Keep the seedlings in active growth as long as possible. Expect flowers in 2–3 years



ZANTEDESCHIA AETHIOPICA 'C ROWBOROL GH'
When planted in moist soil or at pond margins
this calla hily forms large clumps. These may be
tilted and divided as for rhizomatous trises see
p 149) in spring just as they start into growth

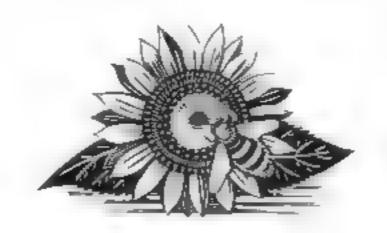
#### OTHER PERENNIALS

UVITARIA Divide after flowering (% c p 149) §. Sow fresh seeds (p.151) in autumn, keep in a cold frame, old seeds germanate slowly and erratically §§ VALERIANA Divide in spring (see p.148) §. Seeds (p.151) in spring at 50°F (10°C) §. Basal stem cuttings (p.156) in spring §. VANCOUVERIA Divide in spring (see p.149) §. Sow ripe seeds (p.151), keep in a cold frame §

VERONICASTRUM Divide in spring (see p 148) § Seeds and cuttings as for Veronica (see facing page)

Waldsteinia Divide after flowering (see p.149) §. Sow seeds (p.151) in autumn §§ Welfenta Divide in autumn or early spring into single roseties, each with roots (see p.167) §§. Sow seeds (p.164) in early spring in pots at 59°F (15°C) §§ NEROPHYLUM Sow fresh seeds in autumn (see p.151) and expose to winter colo. germination is slow and erratic §§§





# ANNUALS AND BIENNIALS

Although short-lived, annuals and biennials make rewarding subjects for propagation – with a little effort and in a short space of time, seed-raised plants ranging from creeping mats to climbers can color the summer garden

Annuals naturally germinate, flower, set seeds and die within one growing season. Biennials produce only foliage in the first year; in the second year they flower, set seeds, and die. Because of the nature of their life cycles, the only way to increase these plants is from seeds.

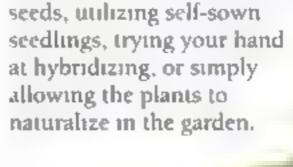
Fortunately, most annuals and biennials are easy to raise from seeds. The seeds rarely become dormant, as do those of longer-lived plants, so they need no special treatment before sowing. They germinate easily and rapidly, providing a display of color very soon after sowing — some annuals flower within a few weeks.

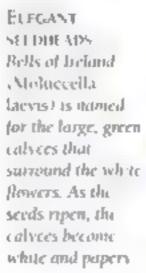
The method of sowing – in containers or in situ – is dictated largely by the hardiness of the plants, the local climate, and how the plants are to be displayed. Annuals and biennials may be grown in their own border, as part of a bedding design, in containers, or as pot plants for greenhouses and conservatories. Biennials need longer-term care than annuals: the seedlings must be grown on for a season and are often raised in nursery beds before planting out

#### PERTILIZED FLOWER

Once pollunated and fertilized, the ovary at the cites of a theorem of Love in the ovary at the damasee to so cite and changes one in Livetops one or attractive toface I seed capsale that can be dried for flower arrangements.

Annuals and biennials are dedicated to only one means of reproduction, and, if they are suited to the climate, many produce produgious quantities of seeds and self-sow with ease. Many popular garden species produce seedlings that, if not completely true to type, are nonetheless pleasing. This offers plenty of opportunity for gathering.







# SOWING SEEDS

Annual and biennial seeds may be sown under cover or outdoors, depending on their hardiness and local conditions. When buying seeds, you may choose F1 hybrid seeds for their uniformity, but naturally or open-pollinated seeds are usually quite acceptable and less costly. With home-collected seeds, bear in mind that only seeds of species come true to type Hybrid seeds will differ in varying degrees from the parents.

#### BUYING SEEDS

If possible, check the date on the packet to make sure that the seeds are from the current season's crop. Seeds are often supplied in foil packets to keep them fresh. Once a packet is opened, the seeds begin to deteriorate, so they are best sown at once. However, if the packet is sealed with tape and kept in cool, dry conditions, most annual and biennial seeds remain viable for a year or more. Seeds of members of the pea family (Fabaceae) last longer. If exposed to moisture, light, or warmth, the seeds viability will decline rapidly.

Seeds may be bought that are treated (see right) to make them easy to handle and to reduce the need for thinning Some seeds, especially very fine seeds of F1 hybrids, are individually coated to form pellets that are large enough to space evenly when sowing. Water them well after sowing to dissolve the coatings and enable moisture to reach the seeds so they can germinate

Water-soluble seed tapes work on the same principle. Lay a tape along the bottom of a drill, cover it with soil, and water in. Untreated seeds may be mixed into a gel, supplied in a kit or made from wallpaper paste, for fluid sowing. The gel is squeezed through a bag to distribute seeds evenly along the bottom of a drill (see also Vegetables, p.284).

Some hybrid seeds that are difficult to germinate may be primed before sale. The germination process has been started but arrested at a critical stage and the seeds dried partially.

#### SAVING YOUR OWN SEEDS

It is best to take seeds from vigorous, healthy plants with good flowers, these are likely to produce the best seedlings. Deadhead others to prevent them from forming seeds. Gather ripe seeds as soon as the seedpods turn from green to brown or black but before they open and shed their contents. On a dry day, pick the seedheads, either singly or on stalks, and lay them out to dry in a warm place. If they do not open when dry, gently crush pods and capsules to

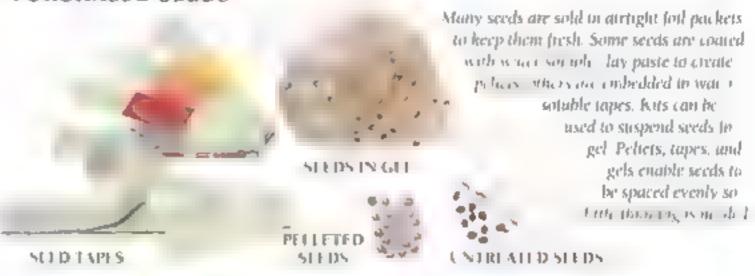
release the seeds (see below). Once separated from the chaff, seeds may be stored in packets or envelopes in a cool, dark place, such as a refrigerator (see below right), until sowing time. Allow at least 6 weeks to pass before sowing

When to sow annuals and Biennials in regions that experience frost, annuals may be started indoors in late winter, spring, or early summer in containers under cover, in temperatures of 55–70°F (13–21°C), according to the genus (see pp 220–29), and planted out when all

danger of frost is past. They may also be sown direct in the open ground (see p.218) in spring where they are to flower, when the soil has warmed up to at least 45°F (7°C). They may also be sown in containers in areas where the open garden soil is heavy and well, which may cause the seeds to rot

Bienmals are sown under glass or (more commonly) outdoors in a nursery bed from late spring to midsummer depending on how fast they grow. The seedlings are transplanted in nursery rows to grow on, then planted in their

#### PURCHASED SEEDS

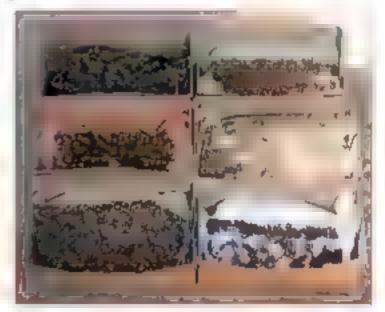


#### GATHERING AND STORING SEEDS



SEED CAPSULES Choose a dry day to gather ripe capsules to ensure the seeds are not damp

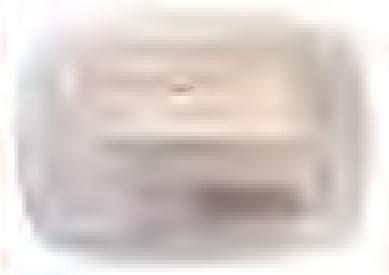
1) the capsules are open or spin, tip or shake the seeds onto a piece of paper for sowing or storing



DRYPNG SEEDIHADS. When seed capsules or pods turn brown, cut them off and place in paper lined boxes or travs. Leave in a warm, sunny spot until completely dry, then extract the seeds



EXTRACTING SEFDS Place dried seedheads into a sieve and hold over a piece of paper Gently break up the seedheads, the seeds will fall through the fine mesh, leaving the chaff behind.

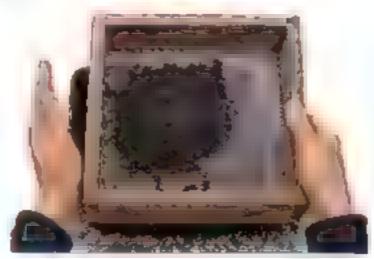


SYORING SEEDS Place cleaned seeds in scaled and labeled paper packets. Store in a plastic box, with a lid, in the bottom of the refrigerator at a temperature of 34–41°F (1–5°C)

#### SOWING ANNUAL SEEDS IN A TRAY



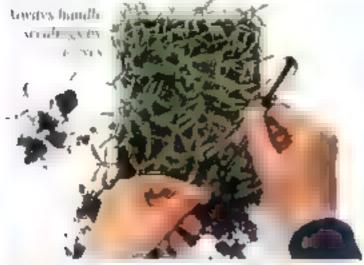
Prepare a tray with seed soil mot. Stand it I in water until the moc surface is moist. Allow to drain thoroughty. Sow the seeds tharly on the surface tapping them from a fold of paper.



Ocover all but very fine seeds with a layer of Soil mix equal to approximately twice their thickness. Use a sieve to obtain a fine texture Afternatively, use vermiculite (see below right)



Place a piece of giass, plastic, or piastic wrap Over the tray to maintain moisture. Cover with netting or newspaper to shade it from direct sun-When germination starts, remove both covers



4 When the seedlings (here mangolds) are large enough to handle, gently knock them out of the container. Life each seedling, keeping as much sail mor around its roots as possible



Iransplant each seedling into a prepared ) container (here a 24-pack), making a hole large enough for the roots. Gently firm the soil mex around the seedling. Water and label

flowering positions in summer or autumn (see p.219).

In warm, frost-free climates, large seeds of annuals and biennials may be sown direct in the open ground as soon as the soil is warm enough, where they are to flower or in nursery beds. Fine or expensive seeds are better sown in containers, where growing conditions are more easily controlled, as are seeds of less vigorous plants. Make successive sowings for outdoor plantings to achieve a longer flowering season

#### SOWING IN CONTAINERS

Pots, pans, seed trays, and cell packs are suitable, depending on the amount or type of seeds to be sown. Too large a container wastes space and soil mix, one too small can lead to thick sowing causing damping of (see p.46) and weak seedlings. Large seeds may be sown in rockwool celis to create plug plants. Degradable pots are useful for plants hat dislike root disturbance

To prepare the container, fill it to its brim with seed soil mix (see p.34). Tap the container to get rid of any air pockets. Firm a soil-based mix reasonably well with your fingertips particularly in the corners, before leveling the surface to about 1/4 in (5mm) below the rim, using a flat wooden board or presser Firm soilless

mix only very lightly before leveling Thoroughly moisten the soil mix by standing the container in water or watering it overhead using a watering can fitted with a fine rose. Add a suitable fungicide to the water to avoid damping off. Allow the container to drain

Sow seeds straight from the packet a fold of paper, or your palm. Tap gently to release the seeds slowly, and sow thinly and evenly over the soil mix Space-sow large or pelleted seeds one by one. Mix tiny seeds with equal parts of line, dry sand to ensure even sowing

No covering is necessary for fine seeds sown with sand - just press the seeds into the soil mix surface with a presser or empty container of the same size. Cover other seeds with a layer of soil mix or fine-grade vermiculite (see above) to keep the seeds in contact with the moist mix. If the covering layer is dry, moisten it with a mist-sprayer. Stopthe mix from drying out by covering the container with plastic wrap or a sheet of glass or plastic or by placing it in a closed case. If necessary, shade the container from direct sun

#### GERMINATING THE SEEDS

The temperature and light needed for germination varies according to the genus (see pp 220-29). In cool climates, a heated closed case on the greenhouse



Vermiculite allows air and light to reach the seeds, so H is useful for covering seeds that require light to germinate it also reduces the risk of damping off Sow as usual in a pot or tray (see step 1) and cover with on Guine Three grade remediate.

bench is ideal but a windowsill in a warm room suffices for a wide range of annuals. Check the container regularly and remove the lid or coverings as soon as germination occurs. Place the container in full light, but shade the seedlings from strong sun. Keep the soil mix moist at all times to maintain steady growth until the seedlings are

TRANSPLANTING THE SEEDLINGS

ready to transplant

Container-raised seedlings should be transplanted into larger containers before they become overcrowded so they have room to develop before being planted in their flowering positions The seedlings will suffer less of a check in growth if transplanted as soon as they can be handled, even if they are quite small (continued on p.218).

SOWING IN A DEGRADABLE POT Sow three seeds m a 2m (5cm) degradable pot Water and label. When seedlings appear thin to one per pot. Plant out the curity pot when the seedlings are established.



#### PREPARING THE GROUND FOR SOWING



Remove all debris and weeds from dug soil

Firm the whole area by shuffling forward with both feet together, until it is flat and free of der pockets. Pay particular attention —edges



2 Rala ever the area or endine terms of engage of the early for serving. This especially the ps for a least seeds settle between the finition of the secret less water it theretiges.

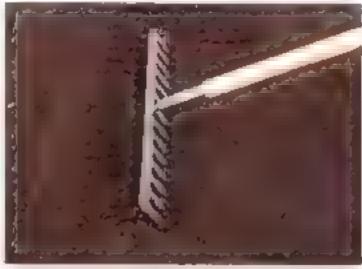
#### **5OWING SEEDS IN ROWS IN A BORDER**



It rist use stakes or twoie to mach to a grid on the seedbed. Then sprinkle grit or sand on the soil to mark out the sowing areas, using a boatle esee (uset) will control the liew of sand. Alternatively six re the soil with a stack



2 t sing a line of string or a stake as a guide draw out drills about 1 in (2 5cm) deep with a five in each sowing area. Scatter the seeds thinly and evenly along the drill (see inset Space sow pelleted or large seeds individually



3 without dislodging the seeds. Firm with the back of the rake. Label each seeds with a fine rose water with a watering can fitted with a fine rose.

(Continued from p.217) Seedlings grown on in cell packs are easy to handle and suffer little check to growth when planted out. Other suitable containers are biodegradable and plastic pots up to 3/4in (9cm) in size, and deep seed trays Seedlings that are destined to be grown in pots should be transplanted first into 3/4in (9cm) pots, then potted on into 5-7in (13-18cm) pots

To transplant seedlings, first water the container and allow it to drain. Tap the container on a hard surface, which should loosen the soil mix so it can be



4 initially, the seedlings may look sparse and appear to be growing in regiment of patterns, but they will soon blend together to form a dense and informal planting

removed intact. Lift out each seedling by inserting a thin stake or similar tool under the root system, taking care not to cause it any damage. Always hold a seedling by the leaves to avoid bruising stems or growing tips.

Make a hole in the soil mix of the prepared container that is large enough to accommodate the roots and stem so that the seed leaves sit just above the soil mix. Firm in each seedling gently Space the seedlings 1½–2in (4–5cm) apart or one to each cell. Keep any smaller seedlings at one end of the

tray so that they do not need to compete with stronger ones and have a better chance of developing evenly

Water the seedlings with a fine-rosed can to settle the roots. Place in slightly warmer conditions to help them to establish quickly. Keep them watered and, in sunny weather, shade with newspaper or netting to avoid scorch

#### HARDENING OFF SEEDLINGS

New plants raised under cover in cool climates will have relatively soft growth, so they need to be gradually acclimatized to outdoor conditions, or hardened off (see p 45), for a couple of weeks before planting out. Hardened trost-tender annuals may be planted out once all danger of frost has passed if conditions prevent planting out, por on the plants or feed regularly so they continue to develop healthily.

#### SOWING SEEDS OUTDOORS

Annuals may be sown outdoors in prepared borders, in gaps in established borders, or in nursery beds for cutting or transplanting. Biennials are usually sown in nursery beds. Avoid very fertile soil, it promotes leaf growth at the expense of flower production. Most annuals and biennials prefer a sunny site.

Prepare the soil well before sowing, when the surface is sufficiently dry so that footwear remains clean and there is no danger of overcompaction. If the soi is lacking in nutrients, apply a balanced fertilizer at 202/sq yd (70g/sq m) or use a liquid fertilizer during growth immediately before sowing, when the soil is moist but not waterlogged prepare the soil surface (see above left)

#### MARKING OUT A BORDER

In a border annuals are best grown in bold, informal groups. Make a plan before sowing, giving consideration to height, habit, and flower color Bear in mind that larger annuals need more sowing space than smaller ones

Divide the sowing area into a grid to help transfer the plan accurately to the ground, then mark out drills at the appropriate spacings in each section (see left). Alternatively, make drills spaced 6–9in (15–23cm) apart throughout the whole area before marking out the plan, or broadcast-sow each section

#### SOWING SEEDS IN DRILLS

Although rows of seedlings may initially seem too formal, they are easier to weed, being readily distinguished from weed seedlings, and to thin (see facing page)

Using the corner of a hoe, draw out the drills, usually 3-6in (8-15cm) apart depending on the eventual size of the plant. Alternatively, press a long stake or the back of a rake firmly into the soil

In practice, sowing depth is not too critical, but drills should be no more than 1m (2 5cm) deep. They should also be of a uniform depth for even germination. Make the drills less deep on heavy clay soil. If the soil is very dry, soak each drill before sowing

Sow the seeds by hand or fluid-sow them along the drills, then cover (see Jacing page). Sow old seeds more thickly because the germination rate is likely to

be low. If there is no prospect of rain. water in the seeds well with spray from a fine-rosed watering can. Keep the soil moist and weed free to obtain the best rate of germination

#### BROADCAST-SOWING SEEDS

This method (see below) is best used when sowing among other plants, for example in gaps in borders. Weeding can be more difficult in the early stages since a hoe cannot be used. Sow the seeds thinly on the prepared surface and rake them in lightly to keep them in contact with the soil. Label and water in well.

#### THINNING SEEDLINGS

Even with the most careful sowing. seedlings will need thinning (see below left) to avoid overcrowding. Many annuals shed copious amounts of seeds, so self-sown seedlings may also need thinning. The best time to thin is when the soil is moist and the weather mild If the final spacing is 8in (20cm) or more, thin in several stages so the growing seedlings protect each other

Use the strongest thinnings to fill sparse areas caused by uneven sowing or poor germination, or transplant elsewhere in the garden. Annuals with taproots such as Clarkia, Gypsophila, and poppies do not transplant well After thinning, water in gently but we,l.

#### NURSERY BEDS

Bienmals are often raised in outdoor nursery beds and transplanted to their flowering positions when large enough (see below). It is usual to sow the seeds from late spring to midsummer transplant them in summer to another nursery bed to grow on. In autumn the young plants are transferred to their flowering positions. Annuals may also be raised in nursery beds for cutting

#### PROTECTING OUTDOOR SOWINGS

Before and after germination, it may be necessary to protect annuals and biennials against rodents, birds, or cats Lay twiggy sticks over the soil surface Alternatively, construct a cage using wire netting (see p 45). Bend the edges down so that the netting is held above the emerging seedlings. You can protect autumn-sown annuals and blenn als against cold or excess moisture by using cloches (see p.39)

#### BROADCAST-SOWING SEEDS



1 Use a roke to give the soil a fine tilth see L acing page). Scatter the seeds thinly and eventy over the prepared seedbed by hand, with a seed sower, or straight from the packet



Rake over the area at right angles to cover the seeds, use light strokes so that they are disturbed as little as possible. Label the area. Wire the x-il using a fine-rosed watering can

#### THINNING ANNUAL AND BIENNIAL SEEDLINGS



INDIVIDUAL SEEDLINGS. To thin seedlings in drills (tiere of larkspur), press down on the sort around the strangest seedlings, while putling our the topyconted weaker ones. Reform and water



SEEDLING GROUPS Lift climps of seedlings here of sweet William Separate them, retaining plenty of soil around the roots of each seedling Replant singly into the bed at even spacings

## RAISING BIENNIAL SEEDLINGS



Sow biennials (here wailflowers) in drills in I a prepared seedbed: keep them well watered In a 1-outh or so, when the seedlings are 2-3in 5 Som) tall lift them using a hand tork



Plane on the sectange it a musery bed ← 6—8an 15 2 hor apart in rous 8-1 in 20-30cm topart. Whom space in each planting. hole for the roots. Firm in label, and water



The dutument, when the new plants are growing well, water the nursery bed if it is dry, then carefully lift the plants. Transplant them to their flowering positions, in well prepared soil

# A-Z OF ANNUALS AND BIENNIALS

Seeds germinate in either light or darkness unless specified. For perennials grown as annuals, see A. Z of Perennials (pp.186-213)

## AGERATUM FLOSS FLOWER

Seeds from late writter to early spring 1

The annuals in this genus may become naturalized in gardens and in the wild in subtropical and tropical climates The seeds are produced in a papery seed capsule and are easily extracted (see p.216) when ripe

A germination temperature in the region of 70°F (21°C) is required and the seeds should take five days to germinate in light. Transplant the scedlings if necessary within seven to ten days. Floss flowers usually take 12 weeks or more to reach flowering size

## AMBERBOA SWEET SULTAN

SEEDS from early to madspring or in autumn 1

The seeds of these annuals and biennials are carried in papery seedheads and are fairly large and easily handled. They germinate at 70°F (21°C) within ten days of sowing in darkness. Seedlings are transplanted, if necessary, within a similar period

Fransplant all seedlings sown in containers into pots or cells (see p 217) to avoid root disturbance when planting out. In cold climates, autumn sowings need protection under cover. Amberboas

flower in 12-14 weeks

## BRACHYSCOME

SWAN RIVER DAISY

SEEOS from midwinier to early spring 11

Collect seeds from the papery, diskake seedheads of the annuals in this genus (syn. Brachycome) as for Helianthus (see p.224), and dry them before storing (see p 216)

Surface-sow the seeds (see p.217), because light is necessary for a good rate of germination. This usually takes 15 days at a temperature of 70°F (21°C) Swan river daisies should flower 12-14 weeks after sowing

## AMARANTHUS

SEEOS from mid- to late spring 1

The annuals and short-lived perennials in this genus are wind-pollinated and often hypridize and seed about very freely. In some climates, Amaranthus can be invasive, but self-sown seedlings are easily removed or transplanted as for Digitalis (see p.223)

The tassel-like flowers are followed by brightly colored seedheads. Small seeds are carried deep within the tassel and cannot normally be seen. The best way to collect the seeds is to "milk" the tassels (see below). Alternatively, remove. the Rowerheads, place them in a paperlined box, and leave in a warm, dry place for a week or so until the seeds fall out

Clean the glossy black or pink seeds by tossing them in a bowl and gently blowing off the chaff as it rises to the top, the seeds will fall to the bottom

Most Amaranthus germinate at 70°l (21°C) in ten days, but Chinese spinach (A. tricolor) requires a minimum of 77°F (25°C) If needed, transplant the seedlings within seven days (see below) If they are transplanted at a later stage the plants will not be vigorous and will probably flower prematurely instead of after the usual 12 or more weeks

Love-hes-bleeding (A. caudatus) may be sown outdoors where they are to flower in midspring, thin the seedlings to 2ft (60cm) apart



AMARANTHUS SEEDLINGS Prick out Amaranthus scedlings ds soon as they have two or four leaves. If the seedlings are disturbed at a later stage, the new plants will not thrive

S GATHERING SEEDS When the flowers there at Amaranthus caudacus pegur to change a for there from deep red to vellow—the seeds an ripe. Hold a tray beneath the flowerhead and gently "mith the tassels so that the seeds. (see inset) fall into the tray

#### OTHER ANNUALS AND BIENNIALS

ADITIMIA PUNGOSA. Sow as soon as ripe in shellend place or adners so p. 9.4 ADONIS Sow as for Centaurea (see p.222-1 AGRUSTIMMA Sow as for Nigella (see p.228), flowers best in poor soil 1 AGROSTIS Sow as for Briga (see p. 221) 4 AIRA Sow as for Briga (see p 221) 1 Acces. Sow as for bicrima. Dranthais. see p 223) L

AMMI Sow as for Centaurea (see p 222) 1 ANCH 5A. Sow seeds of annuals and biennials as for Ageratum (see above) 1 A capensis is best sown direct. ANGELICA: Sow seeds of baranials as soon as they are ripe, light and a temperature of 50-60°E (10-15 5°C) are needed for germination. Transplant seedings as soon. as they are large enough to handle, older seedlings resent root disturbance 11. Seasown A. archangelica seedlings come fairly true. (See also Culmary Herbs, p.290.) ANODA Sow as for Gadiaidia (see p 224) 1. Vertilities Cs. Sow attinua's and biennials as for Centaurea (see p 222). Sow direct in well-drained soil 1

ARGEMONE Sow as for Tagetes (see p 229) 4. ASPERULA Sow as for Centaurea (see p 222) 1 ATRIPLEX Sow as for Centaurea (see p 222), but successively from spring to early summer 1.

BAILEYA Sow as for Centaurea (see p 222) 1. BARBAREA Sow seeds (see p 219) of bienniais as soon as they are rape 1. Bassia Sow as for Callistephus (see p.221) 4. Borago Sow as for Critiannia (see p.222) 1. BROMUS Sow seeds direct outdoors in spring at 50°F (10°C) L CALOMIRIA (5ytt Humea) Sow as for Cleame (see p 222), but as soon as the seeds are ripe [].



## BRACTEANTHA

STRAWFLOWER



Cacteautha. bracteata cultivar SEEDS in early to late spring &

The annuals take 16-20 weeks to flower Seeds are produced in a large, papery seedhead and are easily removed (see p.216) when dry. Although the seeds

are fairly large, do not cover them with more than their own depth of soil mix or vermiculite because they need light to germinate. This takes five days at 70°F (21°C). Transplant the seedlings, if necessary, within seven to ten days

## BRASSICA

SEEOS from early to midspring |

The commonly grown ornamental cabbages or kales (B. oferacea cultivars) belong to this genus. They are quite cold-hardy and are grown as biennials or annuals. Seeds are easily removed from the dried heads (see p 216) and will germinate rapidly at 70°F (21°C), in five days, If necessary, transplant the seedlings (see p 217) within seven days. Ornamental cabbages mature in approximately 16 weeks. (See also Vegetables, p.296.)

## BRIZA QUAKING GRASS

Seeos in early natures or midspring |

Collect the seeds of annual grasses in this genus as soon as the decorative seedheads become fully ripened (see below). Germination requires a temperature of 60°F (15 5°C) and takes 12 days. If necessary, transplant the seedlings (see p 217) within 10-14 days. Seedling grasses generally flower within 14 weeks



GATHERING QUANING GRASS SEEDS Gently pull the seedhead (here of Briza minor) through one hand so that the seeds fall into a ong beneath. (Clean plastic bags are fine for gathering, but not for storing, seeds )

## BROWALLIA AMETHYST

VIOLET, BUSH VIOLET

SEEOS from early to fate spring or in late summer ##

The seeds of the annuals in this genus take 15 days to germinate. Surface sow the seeds, because light is necessary for good germination. Kept at a temperature of 70°F (21°C), the seeds should germinate in 10-14 days. Plants flower in 16 weeks

## CALCEOLARIA POUCH

FLOWER, SLIPPER FLOWER

SEEDS in spring or midsummer 11

There are perennials, biennials, and annuals in this genus. To extract the fine seeds, crush the rounded seed capsules (see p 216). Sow annuals in spring and biennial seeds in midsummer to obtain flowers in the following spring and early summer. The seeds require light and a temperature of 70°F (21°C) to germinate in 15 days. If needed, transplant seedlings in seven to ten days.

Flowering takes up to 36 weeks, but the Anytime Series flowers in 16 weeks at any time of year in suitable climates. (See also Perennials, p. 190)

## CALENDULA ENGLISH MARIGOLD, POT MARIGOID



Art Shades'

SEEDS IT COLD IN IN IN ITE FREE LEVEL

Annuals in this genus are quite hardy and selfsow freely seedlings of cultivars do not come Calendala officinalis true, but the variations may be acceptable

Transplant self-sown seedlings as for Digitalis (see p.223) Take care to preserve all viable parts of the large seeds when collecting them (see below)

Seeds are best direct-sown outdoors (see p.218) at a temperature of 70°F (21°C); they germinate in ten days in darkness. If needed, transplant seedlings in seven days. Protect autumn sowings from severe cold in colder climates Calendulas flower in 10-12 weeks



STRUCTURE OF CALENDLIA SEEDS Calendula seeds frequently break into three parts when they are gathered or while they are stored. Each part can be sown as a viable seed. so take care not to discard them with the chaff

## CALLISTEPHUS

CHINA ASTER



Pompon Series

SEEOS in early to late spring or in early summer 11

The single species of Callistephus and its cultivars are annuals Sow seeds outdoors

albaquius chorensis un midspring at 50-60°F (10-15 5°C)

after the last frosts, or raise plants under cover in containers (see p 217). Sow in the early summer to obtain autumnflowering plants. Most China asters bloom for a fairly short time, so make successive sowings for a longer period of flowering

The seeds are fairly large but should not be covered with more than their own depth of soil or soil mix. Germination takes eight days at 70°F (21°C), transplant seedlings, if necessary, within another seven to ten days. Flowers appear about 20 weeks after sowing

## CAMPANULA

BELLFLOWER

SEEDS in late spring to early some

Canterbury bells (Campanula medium) is a showy biennial. The seeds are carried in a rounded seed capsule, concealed in the calvx at the base of the flower. It is easier to crush the entire capsule and sow the results than sort out the tiny seeds from the chaff

Surface-sow the seeds (see p 217), because they need light to germinate This takes 20 days at 70°F (21°C) Transplant seedlings within four weeks as soon as they are large enough to handle, for flowers in 12 months. In regions with very mild winters, sow direct in autumn for spring flowers (See also Perennials, p. 191)



BIENNIAL CAMPANULA SEEDLINGS Grow on seedlings (here Campanula medium) in nursery beds for the first season while they put on vegetative growth (see above). Plant out into their flowering positions in autumn

## CAPSICUM PEPPER

Seeds in mid- to late spring }

The annuals are mainly cultivated crops, but some with brightly colored fruits are also used ornamentally. The flat seeds are produced in fleshy fruits. To collect them in summer, slowly dry some ripe peppers to allow the seeds to mature, then extract the seeds. Wear gloves to avoid irritating the skin. (See also Vegetables, p. 298.)

50w the seeds the following spring at a temperature of 70°F (24°C). Germination takes ten days, if needed transplant seedlings within a week. The plants start fruiting in 16–20 weeks.

## CELOSIA COCKSCOMB

SEEDS from midspring to early summer [1]

Cultivars of Celosia argentea are grown as annuals. Dry the feathery plumes of the seedheads and shake out the seeds over clean paper.

Germination takes ten days at a temperature of 70°F (21°C). Transplant seedlings within seven days, if needed if sowing seeds in containers (see p 217), do not allow the seedlings to become too established before transplanting, because they do not like root disturbance Pot the seedlings individually into small 3½in (9cm) pots. The plants take 12–14 weeks to flower

## CENTAUREA KNAPWFED



Centuatra

SEEDS in early spring I

Of the annuals and bienmals, the annual cornflower (Centaurea cyanus) and its cultivars are most popular Self sown seedlings come fairly true; treat as for Digitalis (see facing

page). The largish seeds are easily extracted and are best sown direct (see p.218) to flower in 12 weeks. They germinate in ten days at 64°F (18°C) in darkness. If necessary, transplant seedlings (see p.217) in 10–14 days

## **CHRYSANTHEMUM**

SEEOS from ear y to late spring or in autumn !

Some annuals in this genus are quite hardy. Sow the large seeds in early spring in containers (see p 217) or direct in late spring for flowers in 12–14 weeks. In frost-free areas, sow direct (see p 218) in autumn for early flowering. Seeds germinate in 11 days at 70°F (21°C). Transplant, if needed, in seven to ten days. (See also Perennials, p. 192.)

## CLARKIA



br catt

SEEDS in early spring of

Seeds of these taprooted annuals (syn. Godena) are carried in capsules that soon scatter the seeds once they are upe. Sow direct (see p 218) to avoid

disturbing the roots. At 70°F (21°C), seeds germinate in five days. Protect autumn-sown seedlings over winter where marginally hardy (see p 39). Clarkia amoena seeds come fairly true. Flowers in 12 weeks.

## CLEOME SPIDER FLOWER

SEEDS in midspring |

Only annuals in this genus are usually cultivated. The very tender Cleome hassleriana (syn. C. pungens. C. spinosa) and its cultivars are most popular.

Sow seeds (see p.217) at about 70°f (21°C). They should germinate in tendays, but germination sometimes can be erratic. If this is the case, wait until the first seedings have two true leaves before transplanting. Seedlings that are raised under cover are best grown on individually in 3 µin (9cm) pots to prevent root disturbance when planting them out. Plants flower in 16–18 weeks

## CONVOLVULUS BINDWEED

SEEDS from early to late spring I

The most commonly grown annual in this large genus is Convolulus tricolor (syn C. minor) and its cultivars. The seeds form in a rounded seed capsule Convolvulus flowers 12–14 weeks after sowing outdoors

If starting the seeds under cover (see p 217), the large seeds may be sown singly in plug trays of rockwool (see

root disturbance when transplanting Seeds germinate at 70°F (21°C) in about five days

If needed, transplant the seedings (see p 217) within seven days. For seedlings raised in rockwool, simply drop the plug into the center of a preformed rockwool block so the roots can grow into the block without check

## SOWING CONVOLVULUS SEEDS IN ROCKWOOL



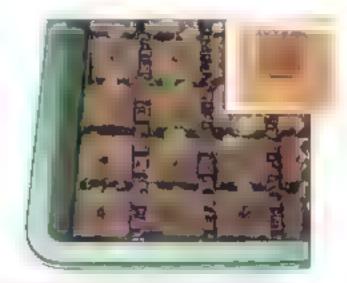
Lange seeds such as those at a new value tricolor may be sown in a tray of tockwood plags. Stand the tray in a drip tray and soak the tockwood with water. Allow to stand for 30 minutes, then dram off the excess.



3 Push a little wad of loose rockwool fiber onto each hole to fill it making sure that there is no air space left above the seed. The divider will absorb moisture from the rockwool plug. Label and place in a warm bright place



2 to sow the seeds, make a hole about a (5mm) deep in the center of each roctivenous page, using a small tool. Drop one seed into case property plag.



4 The sacdings should reach the seed leaf stage in 10-14 days (see above). Grow them on until the roots show through the rockwool. Then plant out as rockwool plugs or pot into a rockwool block (see inset).

## CONSOLIDA LARKSPUR

SEEDS in early and late spring or in autumn 1

The seeds of these self-sowing annuals are poisonous and are produced in a long seedpod. They are best sown direct outdoors (see p 217). Successive sowings are recommended to provide a long season of flowering, especially when cut flowers are required. Autumn sowings will give flowers in late spring, but in colder areas protect seedlings over winter

Seeds sown at 55°F (13°C) take 20 days to germinate. If necessary transplant the seedlings (see p.217) within seven to ten days. Flowers appear in 12–16 weeks

## COREOPSIS TICKSFED

SEEDS THE GRANT COLORS BY

The annuals in this genus self-sow beeds form in papery, disklike heads and are easily removed when dry, as for Helianthus (see p 224). When sown they take five days to germinate at a temperature of 70°F (21°C) in light

fransplant the seedings (see p 217) if necessary, as soon as they are large enough to handle. The plants should come into flower within 12-16 weeks Coreopsis tractoria (syn Calliopsis tractoria) prefers sandy soil

## DIANTHUS PINK, CARNATION

Seeds in late spring and early summer !

The annuals and bienmals in this genus naturally hybridize very readily, so there is often a good deal of variation often quite pleasing, in seedlings from home-collected seeds (see p 216). Many Dianthus are also good subjects for deliberate hybridizing (see p.21). Seeds are formed in a capsule.

Sow seeds outdoors (see p 218) at a temperature of 70°F (21°C), germination takes five days. Bienniais flower 12 months after sowing, but some can be sown as annuals, annuals flower in 16 weeks. (See also Perennials, p. 193.)

## DIGITALIS FONGLOVE

SEEDS to lake spring &

The deep, tubular flowers of foxgloves attract nectar seeking bees, which pollinate the plant. Seeds are produced in great quantity in papery capsules to enable the foxgloves to self-sow with ease. Self-sown seedlings can be lifted and transplanted (see below).

Cultivars come reasonably true to type although there is some, usually pleasing, variation. Collect the ripe brown seed capsules just before they split and release the seeds. These, like

## SELF-SOWN SEEDLINGS



1 Forgloves there Digitalis purpures readdy self sow around the garden. Seed capsules form along each flower spake in early or midstemmer and, when tipe, they split open to shed copious amounts of small seeds



3 lift the seedlings with a hand trawel so that each retains a good ball of soil around its roots. This protects the roots from dam zeroid ensures that the seedlings establish rapidly

all parts of the plant, are poisonous, so take care when sorting and cleaning them (see p 216)

Biennial foxgloves require a temperature of 70°F (21°C) in light to germinate, this should take 20 days if needed, transplant seedlings within seven days.

Seedlings with dark stems are more likely to have purple flowers. Some cultivars flower 20 weeks after sowing but usually they flower the following year in late spring and early summer



2 Look for seedlings at the foot of the parent plants in fate stonage or early autione. Choose a cook damp day to avoir drying out the seedlings' roots, and transplant those with at least four leaves into better flowering positions.



4 Transplant the seedings at least 12m 30cm) apart Replant each seeding at the sort depth as before, with its roots well spread out from it in gently, water, and label

#### OTHER ANNUALS AND BIENNIALS

CARTHAMOS Sow annuals as for Centaurea (see p 222): biennials as for Callistephus (see p.221) [. CENTAURIOM (syn. Erythraea) Sow annuals and biennials and 50°F (10°C) when seeds ripen or an inidautumn [. CEPHALIPTERUM Sow as for Bracteantha (see p.221) [. CHRITA Sow seeds of annuals

(see p 217) in succession from late winter to spring, at 66-75 F (19-24°C) 444. CLADANTICS Sow as for Callistephus (see p 2°1) 4. Conc. Sow as for 2001 a (see p 229) 4. COLLINSIA. Sow as for Clarkia (see p.222) 4. Thin automn sowings in spring. Self-sown

C bicolor seedlings come fairly in a seeds are best sown direct Collomia Sow as for Clarkia (see facing page) § Cotota Surface-sow (see p.217) seeds of annuals at 55–64°F (13–18°C) in spring §§ Creas Sow seeds of annuals (see p.218) as soon as the seeds ripen at 50–59°F (10–1 × C. §).

CYNOGLOSSEM Sow seeds of annuals and breamials outdoors in midspring. Needs light to germinate J. C. aniabile is best sown direct. Discorphismed A. Sow as for Brachyscome (see p.220), but

cover the seeds with soil mix !

## DOROTHEANTHUS

ICE PLANT, LIVINGSTONE DAISY

SEEDS from early to midspring 4

Seeds of these annuals are produced in a fleshy capsule that should be dried thoroughly before removing the fine seeds. Sow them at a temperature of 70°F (21°C) for germination in ten days and flowers in 16 weeks. Transplant the seedlings, if needed in seven to ten days. In colder regions, if sowing in containers under cover-(see p.217), harden the seedlings well (see pp.218 and 45) before planting them out.

## ERYSIMUM WALLFLOWER

SEEDS in late spring or early summer 1

The few annual and biennial species produce seeds freely in long pods They are easily removed once the pods have been dried (see p.216) and have split open. Sow the seeds at 70°F. (21°C) to germinate in five days. When transplanting the seedlings (see p. 219), trim the taproots to promote formation of fibrous roots to help plants establish more easily after planting (See also Perenmals, p. 196.)

## GAILLARDIA

BLANKET FLOWER

SEEDS in early spring &

The annuals in this genus bloom heavily The seeds, produced in papery cases, are fairly large and easily handled. Sow in containers in colder climates (sec. p.217). Germination takes 20 days at a temperature of 70°F (21°C). Seedlings are transplanted, if necessary, within seven to ten days. Plants flower in 16 weeks. (See also Perennials, p 197.)

## GYPSOPHILA BABY'S BREATH

spring \$



The annuals in this genus are easy to propagate from seeds, germination can take up to ten days. They are best sown direct (see p 218)

SEEDS in early to mid

Cryptophila ciegons

because they do not transplant well Sow at 70°F (21°C). If necessary, transplant the seedlings as soon as they are large enough to handle. The annuals flower in 12-15 weeks. (See also Perennials, p 199)

# ESCHSCHOLZIA CALIFORNIA POPPY

Seeds from early to the spring and in early

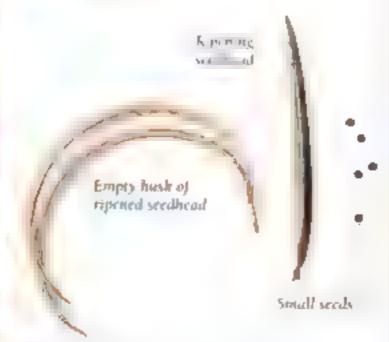
The annuals are quite hardy and produce seeds very freely, so self-sown seedlings that are fairly true to type readily arise They do not transplant well, however, so it is best to gather the seeds before they are scattered (see below). Sow the seeds direct outdoors (see p 218)

Germination usually takes ten days at a temperature of 60°F (15 5°C) Carefully transplant seedlings singly if necessary, within seven days Sow successive batches of seed for a prolonged flower display. In colder climates, protect autumn-sown seedlings in winter California poppies generally flower in 12-16 weeks

#### GATHERING CALIFORNIA POPPY SEEDHEADS



UNRIPE SEEDHEADS To gather the seeds, remove the long, thin pods as soon as they turn color from green to brown in early to midsummer, before they burst open and scatter the seeds



RIPE SEEDHEADS As each capsule dries in the sun, tension builds up within its walls Eventually, the capsule explodes, ejecting the seeds with great force to disperse them as far from the parent plant as possible

## HELIANTHUS SUNFLOWER

SEEDS from late winter to early spring \( \)

The flowerheads of the annuals in this genus are often large and can be 12in (30cm) or more across. The large seeds form in a disklike seedhead in the center of the flower and are easily extracted (see below). Bear in mind. however, that the cultivars hybridize very freely and therefore may not come true from collected seeds. Sunflowers are worth experimenting with to create new hybrids (see p.21).

Sunflowers resent root disturbance. so sow direct (see p.218) or singly in pots (see p 217) or tockwool plugs (see Convolvulus, p. 222) Germination is reliable and takes five days at an optimum temperature of 70°F (21°C) If transplanting is necessary, carry out within seven days and replant a little deeper than before to support the seedling stems, Sunflowers bloom in 16-20 weeks. (See also Perennials, p 200.)

#### EXTRACTING RIPE SEEDS



🔰 In late summer or early autumn, choose a A sunflower head shere of Heliamhas annuns) that is about to go over and cut if off. Carefully rub off the chaft from among the rate seeds in the center of the flowerhead



Grip the flawerhead firmly in both hands and bend it so that the seed mass opens up slightly. Hold the flowerhead over a clean sheet of paper and stroke it firmly with one hand. The seeds should pop out and fall onto the paper

## IBERIS CANDYTUFT



SEEDS from early spring to early summer or in autumn I

The annuals in this genus produce great quantities of seeds in pods after flowering in spring or summer Sow the seeds outdoors (see p.218) in successive

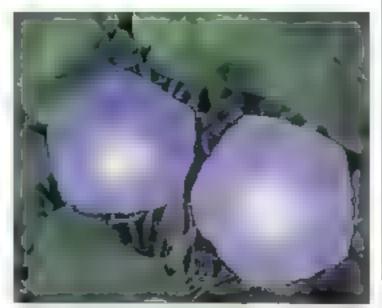
batches for a long and continuous display, and in autumn for early flowering in the following year. The seeds germinate readily in eight days at a temperature of 70°F (21°C) Candytuft plants take 12-16 weeks to flower

## IPOMOEA MORNING GLORY

SEEDS from midspring to early summer \$

The climbing annuals, which are most often grown from this genus, are quite tender. The seeds, produced in rounded capsules, are large and easily handled but are toxic if ingested. Soak them in tepid water for 24 hours before sowing and keep them at a temperature of 64°! (18°C) to ensure good germination This usually takes five days

Sow the seeds singly in containers (see p.218) in cool climates, outdoors in warm climates. If needed, transplant the seedlings in seven days. Morning glories (syn Mina Pharbitis) like a fertile soil mix. They flower in 16 weeks



IPOMOLA TRICOLOR 'HEAVENLY BULE' Morning giories, once germinated, require a ir immum temperature of 45% (7%) and fertile. soil, they flower abundantly diaring summer

## IMPATIENS BALSAM.

BUSY LIZZII

SEEOS from early to late spring \$1

The annuals range from very tender species such as Impatiens balsamina to hardier ones such as I glandulifera The latter can be quite invasive

The riperied seed capsules burst open and violently eject their seeds The best way to collect the seeds is to tie a tiny bag over each capsule as soon as it changes color. Remove the bag once the capsule has released its seeds

Géritination requires à temperature of 70°F (21°C) in light and takes 15 days. Transplant the seedlings, if necessary, within a similar period of time Impatiens seedlings are prone to damping off (see p.46), and they scorch in hot sun. They take 12-16 weeks to flower



RIPENING IMPAILING SEEDHEADS When repe, the wally of each secuberal spin apart and coil backway I so suddenly that the seeds one ejected several Jeer from the plant

## LAGURUS HARE'S TAIL

SEEDS III spring of autumn 1

The only species of Hare's tail Lagurus ovatus, is grown for its fluffy flowerheads, or inflorescences, which, when dried, remain injact for a considerable time. Hare's tail grass is a good choice for poor, sandy soils in full sun. In some regions, it has naturalized and become a weed. Collect the seeds m the same way as for Briza (see p 221) as soon as the flowerheads ripen and become fluffy in the summer

Sow the seeds direct (see p.218) in spring for flowers in 12 weeks. In colder clunates, autumn sowings should be made in containers (see p 217) and placed in a sheltered place over winter

Seeds need a minimum temperature of 64°F (18°C) for germination, which normally takes ten days. If necessary transplant seedlings within 10-14 days

#### OTHER ANNUALS AND BIENNIALS

Dewennera Sow seeds of annuals as for Phlox (see p.228) 1 Dracochrishum, Sew as for Centaured (see p 222) 1 ECHIOM Sow seeds (see p 217-9) at 55-61°F (13-16°C) annuals in spring, bignitials in early sunimer 👪 EMILIA (syn. Cacalia) Sow seeds of annuals as for Callistephies (sec p 221) 1 ERAGROSTIS Sow as for Briga-(see p 221), but in midspring 4. EUPHORU A Sow annuals in spring as for Aigella (see p 228) beamals as for Erysimium see facing page) 1. (See also Cacit and Other Succisents p.246.) ELSTOMA (syn. Lisianthus) Sow

seeds (see p.217) of annuals and in early spring or autumn at biennials at 55-61°F (13-16°C) in autumn or late winter 🚻 EXACOM Sow annuals and be amaly as for brownline execp 221), but lightly cover seeds with soil mix 12 FELICIA (syn. Agathara Now seeds of annuals as for impatiens (see above) } GIFFA Sow as for Calendala (see p.221) 1. GLACTEM Sow as for Calendula (see p 221) L. Resents root disturbance GOMPHRENA SOW SCOUS OF annuals as for Imparans (see above) ‡ HEMOPHILA Sow as for Centourea (see p.222) L. For winterflowering container plants, sow

61-66% (16-19%) HISPERIS Sow seeds of biennials in spring in final position (see p 218): germination requires a temperature of 50-59°l 10-15°C) 1. Self-sown H matematis seedlings come lairly true Hillisetts Sow seeds of annuals (sec pp.217-8) at 64°F (18°C) in spring; soak seeds in hot water for an hour before sowing 11 (See also Shrubs and Climbing Plants, p. 131 ) HORDEUM Sow as for Briga-(see p 221) L HYOSCHANIUS Sow seeds (see pp.217-9) of annuals and biennials in spring. Taprooted seedlings resent root

disturbance so sow in flowering positions. Henbane often se f sows freely 1 tenorsipiem. Sow seeds of annuais in spring, summer, or autumn (see p.217) Plant often self-saws 1 fromorsis Sow seeds of annuals and biennials (see pp.217-8) at 55-61°F (13-16°C) in early spring or in early summer 11 INATIS Sow seeds of annuals and biennials (see pp 217-8) in autumn or spring at 13-18°( (55-64°F) Self-sows freely 4 LAGINARIA Sow seeds of annuals as for Capsicum (see p 222), but soak seeds in tepid water before sowing |.

## LATHYRUS SWEET PEA



Lathyrus Mars'

Seeos from midautumn to in dwinter or from early to midspring 11

The most commonly grown annual in this genus is the sweet pea Lathyrus odoratus, most often a climber. The seeds, produced in long

pods, are large and easily handled. Pick seedpods when they turn pale brown and rattle. Dry them (see p 216) until they split and release the seeds

In Hardiness Zones 8-9, sweet peas are best sown in midautumn or late winter, but early spring sowing can still give good results

For the best flowers, the ground should be enriched some time before sowing. Dig over the soil in a trench or block, depending on if the stake supports are to be erected as a trellis or tepce. If the soil is heavy, prepare it in autumn for spring sowing so it can be broken down by frost action, or raise the bed

Sow direct in the open ground (see below right) in early to midspring or in autumn in warm areas. In cold regions sow in containers (see bottom left) in autumn and winter and germinate in a sheltered place, such as a cold frame fined with 2m (5cm) of gravel. The optimum germination temperature is 55°F (13°C) in darkness

To aid germination, soak the seeds overnight in tepid water. Sow the seeds immediately, if left too long, they are prone to rot. Some black seeds of cultivars are impervious to water and must be chipped (see below left) to allow moisture to reach the seed embryos. However, some growers consider both soaking and chipping unnecessary. Germination takes 15 days.

Seedlings that have not been raised in individual containers are transplanted into open ground or are first potted individually into deep 3in (8cm) pots when they are about 2in (5cm) tall. At all times they must be grown as cool as

possible, being given protection only if the weather is very cold. In warm conditions, the seedings grow too quickly and become leggy, or they die

Whereas it is not necessary to pinch out the tips of autumn-sown seedlings, it is useful for those raised in winter or spring to encourage sideshoots (see bottom center). For exhibition-quality plants, allow one shoot to develop, support it with a stake, then remove all tendrils and sideshoots to concentrate growth into flower production

Sweet peas should start flowering within 12–14 weeks, depending on time of sowing, but autumn sowings will not flower until spring or early summer

hybridize, and many amateur gardeners have produced some excellent cultivars. Pollinate the chosen seed parent (see right) and protect it from insect pollination by tying a muslin bag over it for a few days. Collect the seeds in late summer (See also Hybridizing, p.21)

#### CHIPPING SEEDS



Chip the hard coats of place seeds by using a clean, sharp kinfe to cut away a small piece of each seed coat, or use a soldering gun to burn a truy bole. Take care to make the cut well away from each seeds sear (lutan).

#### SOWING SWEET PEA SEEDS OUTDOORS



PRIPARING THE SOIL Dig over the soil in a trench or block, according to how the weeds are to be sown. Add 3-4m (8-10cm) of well rotted manure or compost to the bottom of the trench. Those to settle for at least four weeks.



Direct-Sowing Under A TEPH: First construct a tepec of sex 8ft (2.5m) stakes. Make a hole about 1 m (2.5cm) deep on both sides of each stake. Sow a few seeds in each hole cover over, and firm. Water in if the soil is div

#### SOWING SWEET PEA SEEDS IN CONTAINERS



I Sow sweet peo seeds in deep containers that allow room for the seedlings' roots. Fill 5in (13cm) pois with seed soil mix, and space-sow 5-7 seeds per pot. Cover the seeds with %in (1cm) of fine-grade vermiculite, label, and water



2 Leave the seeds in a cool, sheltered place in colder climates a cold trame is ideal. To promote bushy growth, pinch out growing tips when the seedlings have two or more pairs of leaves. Plant out as soon as the roots are visible.

#### USING TUBE POTS



To avoid disturbing the seedlings' roots, sow the seeds in time pots instead of standard pots. Almost fill the tube pots with seed soil mix. Sow the seeds singly and cover with oin (1cm) of mix. Label and water

#### HYBRIDIZING SWEET PEAS



Lathyrus Mars) that has one or two unopened flavers. Pinch off open flowers, they are already pollinated (sweet peas are self polanating). Also remove any inimature flowers.



2 Hold back the wings of the seed parent
liower to expose the keel Using a needle of
a safety pin, pry open the keel to reveal the ten
stamens with their pollen bearing anthers



3 Use face tweezers to punch off all the stannens from around the central stagma lake care not to damage the stagma or to leave any snags that could encourage rot



A lake a fully open flower of the pollen parent there Lathyrus 'Margaret Jovee'). Holding at by its wings, place its keel over the seed parents stigma. Shake the pollen flower to transfer its ripe potten to the seed parents stigma.

## LAVATERA MALLOW

SEEDS from early to late spring or early summer []

These annuals and biennials have disklike seedheads. Sow annuals in spring and biennials in early summer in a sheltered place. The seeds take 14 days to germinate at 70°F (21°C). Transplant seedlings, if necessary, within seven days. Annual mallows flower in 12–16 weeks. (See also Shrubs and Chimbing Plants, p.133.)



SORTING SEEDS FROM THE CHAFT
Mallow seeds have three coats of layers of chaft
some layers only fall away. When storing or
sowing seeds, be sure to discard all loose chaft

## LINARIA TOADFLAX

SEEDS from early to midspring or a summer 1

The annuals in this genus are the most often grown, although there are some biennials, which are sown in early summer. Seeds are produced in dry capsules. Sow ourdoors (see p. 219) the seeds are relatively small, so take care not to sow them too thickly.

The optimum temperature for germination is 55°F (13°C). Seedlings appear in ten days, if necessary transplant them as soon as they are large enough to handle. Most plants take 12 weeks to flower. Annual toadflax self sows very freely, transplant the seedlings as for Digitalis (see p. 223).

## LUNARIA HONESTY,

MONEY PLANT

SEEDS in early summer |

Lunaria annua (syn L. biennis) may be annual or biennial but it is usually grown as a biennial Being very free-seeding, it naturalizes very readily and self-sown seedlings are easily transplanted, as for Digitalis (see p 223). The prominent flat, translucent seedheads are valuable for dried flower arrangements.

Dry the seedheads thoroughly before extracting the seeds (see below). The seeds take 14 days to germinate at 64 i (18°C). Transplant the seedlings, if necessary, within two weeks. If grown as a biennial, flowering is in late spring or early summer of the following year.



GATHERING HONESTY SELDS

In summer, when most of the flat seedheads tala
in the appearance and texture of silvery tissue
paper, the seeds are type. Cut off a flower stem
and peel away the outer skar from each side of
a seedhead. Pick the large flat seeds from the
central order membrace.

#### OTHER ANNUALS AND BIENNIALS

LWM Sow seeds of annuals as for Calendala (see p.221) 4
LEGOUSIA. Sow as for Calendala (see p.221) 4
LEGOUSIA Sow as for Calendala (see p.222) 4
LIMMASTRES. Sow as for Calendala (see

LIMSASTHES Sow as for Ca ordala (see p 221) but protect autumn sowings over winter in colder regions § Self sown L. douglasti seedlings come fairly truc Limasthes Sow as for Centaurea (see p 222) § LISOHLIMITRA Sow as for Centaurea (see p 222) §

Flowering flax (L. grandiflorium) dislikes root disturbance, so sow seeds direct (see p.218)

LOBELIA Sow seeds of annuals (see p.217) at 59–77°F (15–25°C) in late winter and early spring Readily self sows in suitable chinates 44. (See also Perennials, p.202.)

LOBI LARIA Sow seeds of annuals (see p 218)

in early to late spring at 50–59°F (10–15°C) \$. Self sown L. maritima seedlings come fairly true

Lowas Sow as for Centainea (see p 222) \(\frac{1}{4}\)
Letisus Sow as for Centainea (see p 222)
after nicking the seeds or soaking them
for 24 hours \(\frac{1}{4}\) (See also Perennials, p.202.)
Uversus (syn. Viscaria) Sow as for Erysomon
(see p 224) \(\frac{1}{4}\)

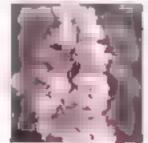
Matcornia. Sow seeds of annuals (see p.218) from late spring at 4–6 weekly intervals for succession of flowers germinates at 50–59°F (10–15°C) Levelf sown M. maritima seedlings come fairly true to type

MALOPE Sow as for Centaurea (see p 222) 1. Self-sown M. trifida seedlings generally come fairly true.

Matsa. Sow seeds of annuals and blenn a sias for Centaurea (see p.222) or Erystmum (see p.224).

## MATTHIOLA GILLYFLOWER.

STOCK.



May be It

Gam, Exectsion

Seeds roni midwinier to midspring or an musiummer 11

Annuals in this genus are best raised in containers (see p.217) under cover in colder climates, but there are

different cultivars for different seasons Seeds are produced in abundance in long, narrow pods and germinate in ten days at 70°F (21°C)

Transplant seedlings within a week or so Double-flowered cultivars can be selected at the seedling stage. Moveall the seedlings to a place below 50°F. (10°C) those seedlings whose seed leaves become yellowish green will then develop double flowers

In cold regions, protection (see p 39) over winter will be necessary for biennial stocks grown for autumn transplanting. Annual stocks flower in 12-16 weeks, biennials the following spring

## MYOSOTIS FORGET-ME-NOT

Seeos in late spring or early storage 4

The biennial cultivars of Myosoris sylvatica are most often grown. They self-sow freely and come reasonably true to type. Lift spent plants and lav them under shrubs or in woodland so they can shed their seeds and become naturalized. To save seeds, lay the entire plant in a paper-lined seed tray to dry (see p 216), the seeds should fall into the bottom of the tray.

Sow the seeds outdoors (see p.219) or in containers (see p 217). Sow seeds of M arvensis in spring. Germination occurs at 55°F (13°C) in darkness in about five days. Transplant the seedlings to a nursery bed, then in their flowering positions in autumn. Biennials flower in spring of the following year

## NICOTIANA

FLOWERING TOBACCO

SEEDS in early to late spring 1

Annuals in this genus produce seeds in oval capsules in summer and autumn The seeds are very fine and need light for germination; mix them with fine sand and surface-sow them (see p.217) They require a temperature of 70°F (21°C) in order to germinate in 20 days. Seedlings are transplanted, if necessary, within seven days. Flowering tobaccos take 12 weeks to reach flowering size

## NIGELLA LOVE-IN-A-MIST, DEVIL-IN-A-BUSH

SEEDS from early to midspring or early to Laurenteebem

These quite hardy annuals have inflated seed capsules, gather them as they ripen (see below). They also self-sow freely, producing copious amounts of seeds that scatter on the ground around the plant. Nigella damascena seedlings come fairly true; lift and transplant them as for Digitalis (see p 223)

#### GATHERING MIGELLA SEEDS



J In summer, when the seed capsules begin to A turn brown, cut them off and place them in a saucer or tray fined with clean blotting paper of newspaper Leave them in a warm, wonly place until the seedheads are completely dev

Sow seeds outdoors (see p 219) when the soil temperature reaches 64°F (18°C) Seeds germinate readily within ten days. If necessary, seedlings should be transplanted in seven to 14 days. Autumn-sown seedlings need protection (see pp.39-40) over winter in colder chimates. Plants flower in 12-16 weeks, or in the following spring if they are autumn-sown



3 Shake out the small seeds from the dried capsales onto some clean paper. If necessary, steve through a fine-meshed steve to winnow out any chaff. Store the seeds in labeled paper packets in a cool, dry place

## PAPAVER POPPY



Paparer choose Shuley Seney

SEEDS for months to midspring of there late spring to early summer 1

There are annual and biennial poppies. The distinctive "pepper pot" seed capsules produce large quantities of seeds and readily self-sow

Papaver thocas seedlings come fairly true. Gather capsules as they change color, and lay in trays to ripen. Simply shake out the seeds (see p 216)

Sow annuals in spring and biennials later. They germinate readily, in 20 days at 55°F (13°C) in light. The tap-rooted seedlings resent root disturbance so are best sown direct or transplanted once they have two true leaves, or within seven days. Annuals flower in 12 weeks, biennials the following spring or summer (See also Perennials, p 2(14)

## PHLOX

SEEDS from early to late spring 11

There are a few annuals in this genus The seeds, produced in oval capsules, germinate within ten days at a temperature of 64°F (18°C) in darkness, and the seedlings are transplanted, if necessary, within a week. Annual phlox flower in 12-16 weeks. (See also Perennials, p 206.)

## RESEDA MIGNONETTE

SEEDS early to inidspring or early to midautumn [

Most often grown is the fragrant annual Resedu odorata. To collect seeds, remove and dry flower spikes before the small seed capsules split (see p 216). Seeds germinate at 70°F (21°C) in five days If needed, transplant seedlings in seven to ten days. Protect autumn sowings over winter in colder regions (see pp 39-40). Annuals flower in 12-16 weeks, autumn sowings in spring.

## RUDBECKIA CONFFLOWER

SEEDS from early so midspring !

The seeds of these annuals are easily removed from papery seedheads. It raising in containers, do not sow too deeply Seeds germinate in 20 days at 70°F (21°C). If needed, transplant seedlings within seven days Concflowers take 20 weeks to flower

## SALVIA SAGE

SEEDS in early to late spring |

The annual Salvia coccined and splendens (scarlet sage) are the most widely grown. Save seeds as for Resedu (see above) They germinate at 70°F (21°C) in light in 15 days. Transplant seedlings in seven to ten days for flowers in 16 weeks. (See also Perennials, p 208.)

## SCHIZANTHUS BUTTERFLY

FLOWER, POOR MAN'S ORCHID



Schizanthus phinatics

Secos in early spring to early summer or in late summer 4

These showy annuals and biennials flower in 12–16 weeks. Sow annuals in spring for summer flowers or in late summer for winter-

flowering container plants. Cover seeds only very thinly Germination at 70°F (21°C) in light is in seven days. Transplant seedlings, if needed, within a week

## TROPAEOLUM NASTURTIUM

SEEDS from mulspring to early summer |

Most of the annuals self-sow readily and come fairly true; transplant as for Digitalis (see p 223). To save the large seeds, pick them individually when ripe and dry before storing (see p 216) Germination takes eight days at 64°F (18°C) in darkness. Transplant the seedlings, if needed, within a week Nasturtiums flower best on poor soils in 12–16 weeks. Some Tropacolum majus cultivars, such as 'Hermine Grashoff', are increased not from seeds but from basal stem or stem-tip cuttings (see pp 154–7)

## VERBASCUM MULLEIN

SEEDS from early to late spring or early summer 11

Most species are bienmals, but a few are annuals. To save seeds, remove and dry flower spikes before the seed capsules split (see p.216). Mix seeds with fine sand, then surface sow at 55°F (13°C) Germination takes 14 days. Transplant the taprooted seedlings, if necessary, as soon as possible afterward – into individual pots if raising them in containers. Some plants may flower in 20 weeks from an early sowing, later sowings the following year (See also Perennials, p.212.)

## TAGETES MARIGOLD

SEEDS early to late spring |

Marigolds produce copious amounts of large seeds in feathery seedheads. Cultivars freely hybridize and do not come true from collected seeds, but the seedlings are often pleasing, it is worth experimenting with creating your own hybrids (see p.21).

To save seeds, pick and dry entire seedheads (see p 216) once they mature Sow seeds without removing the "tails." Seeds germinate easily, at 70°F (21°C) in only five days. If needed, transplant the vigorous seedlings within seven days. Flowers appear in 8–12 weeks



HARDENING OFF MARICAN D SEEDLINGS
In colder clanutes, seedlings that have been raised
indoors need to be hardened off under a cover or
in a cold frame for a few weeks before planning
out New has the secular go office och have

## ZINNIA

Seeos from early to midspring II

All species in this genus, including the annuals, are quite tender. The seeds, produced in disklike seedheads, are large and easily handled. To save seeds, cut the entire flowerhead after the petals have faded and dry before removing the seeds as for Helianthus (see p.224).

Sow at a temperature of 70°F (21°C) Germination is rapid, within five days. Transplant the seedlings (see p 217), if necessary, within seven days, they dislike root disturbance, so pot them singly into cells or degradable pots Zinnias flower in 16–20 weeks

#### OTHER ANNUALS AND BIENMALS

MENTZELIA Sow annuals as for Centaurea (see p.222) ‡ Mottice RUA. Chill seeds of annuals at 34-41°F (1-5°C) for two weeks, then sow (see p 218). at 55-64°8 (13-18°C) in spring L NEMPSIA Sow seeds (see p 217) of annuals at 60-70°E (15 9-21°C) from early to late spring |. Germination may be erratic above 68°F (20°C) Leave woolly covering on seeds, they germinate best in total darkness NEMOPHICA, Sow seeds of aumans (see p.218) from early to late spring at 50-59°F (10–15°C) L Seedlings dislike mot disturbance. Self-sows freely, N CANORA PENNALUDES, SOW as for Centaurea (see p.222) 1. Self sows freely NOLANA Sow as for Callistephus (see p. 221) 1 DENOTHERAL Sow annuals as for Centaurea (see p 222), bienmals as for Erysimum (see p.224), or in early autumn 4. Self sown

O. biennis seedlings come true

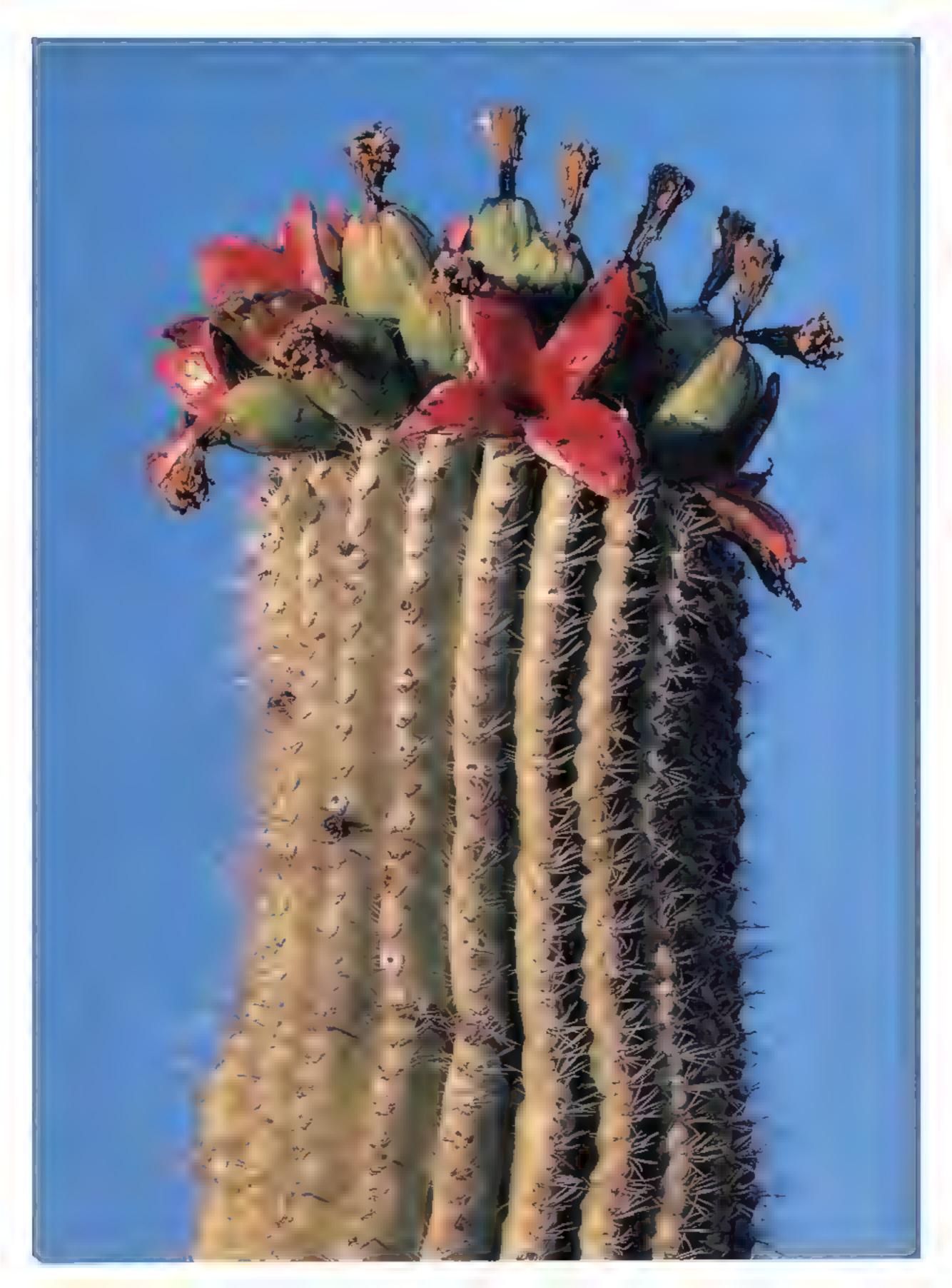
Ostrustoots: Sow annuals as for Centaurea (see p 222) § Self sown O. limfolia seedlings come fairly true

Onoronnum (syn. Onopoidon) Sow seeds of bienmals (see p 219) at 50-61 F (10-16°C). an late spring or early summer where they are to flower 1 Self sown O manthum and O. nervosum seedlings come true PANICEM Sow annuals as for Chrysanthemum (see p 222) 1 PERILLA Sow seeds as for Chrysanthemum (see p.222) L PHACELIA Sow annuals as for Angella (see facing page); sow biennials direct in autumn L PLATISTEMON CALIFORNICES, Sow. as for Centaurea (see p 222) 1 Seedlings come fairly true Penyposess. Sow as for Briga-(see p.221) L PORTELAÇA Sow as for Dorotheunthus (see p 224) 44 PROBOSCIDEA (Syn. Martyria) Sow as for Tagetes (see above) | PSYLLEGIFACHYS Sow bigumals as for Tagetes (see above) and

annuals as for Rudbackia (see Jacing page) 1 Ruodastnii (syn Acrochmiun) Sow as for Rudbeckia (see p 228) [ Saumunosas Sow as for Tageles (see above) L. SUNVITALIA Sow as for Calendala (see p 221) 1 SCABIOSA. Sow seeds of annuals and biennials as for Calendara (see p 221), but in spring 1 SLEEK M. Sow as for Centaurea (see p 222) 1. Sitese Sow seeds (see p.217-9) of annuals at 50-59°F (10-15°C) in autumn or spring |... Scilesown 5 armena seedlings come fairly true. MINIM S. Sow seeds of annuals or biennials direct (see p.218-9) in late spring or early summer Thin to 2ft (60cm) 4 SMYRNILM Sow seeds (see p.218) of bienmals in flowering position at 50-59°F (10-15°C) in

autumn or late spring Germination is greatic 🚻 THYMOPHYLLA: Sow seeds of annuals and breamals as for Matthiola (see facing page) 1. Tituosia. Sow as for Zoona. (see above, 1. TRACHYMENE (syn. Didiscus) Sow at 70°F (21°C) in midspring, germination may be slow 🚻 👚 TRAFA Collect ripe seeds of annuals in autumn. Store frost free in wel moss or water over winter Sow in spring at 55-64°F (13-18°C) in wet soil msx II. (See also Water Garden Plants, p. 170 )

> SCABIOSA ATROPURPURFA COCKADE SFRIES





# CACTI AND OTHER SUCCULENTS

The sculptural, often bizaric forms of this extraordinary group of plants belie the comparative ease with which many in cultivation may be propagated.

Succulents evolved to survive in habitats with extreme conditions, particularly periods of drought. They store water in specialized tissue in swollen roots, stems, or leaves. Many desert species have tiny leaves, or no leaves at all, to retain moisture; others are rainforest epiphytes, living in trees and absorbing water through straplike stems. Cacti make up one family of stem succulents, distinguished by a unique feature the areole, a padlike bud from which flowers, shoots, and spines grow. All cacti are succulents, therefore, but not all succulents are cacti

Other succulents span many plant families and so are very diverse in form, from stark, cactuslike barrels to treelike leafy species, and also in the ways they may be propagated. Some techniques such as stem and leaf cuttings, are broadly similar to those used on herbaceous perennials but with the advantage that succulent cuttings do not will as quickly. However, the fleshy cuttings are very susceptible to rot, so good hygiene is essential for success. In the wild, many succulents increase by forming spreading clumps of rosettes, globular

SAGUARO CACTUS IN FLOWER

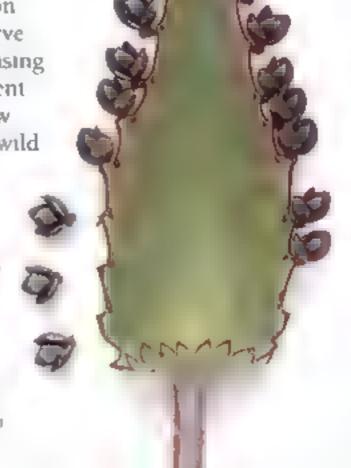
This cactus. Carnegues gigantes, takes 150 years to grow 40 t (12m). After 40 years, the first flowers appear setting 10 million seeds a year only one seedling survives in five years. Seeds germinate readily in cultivation.

offsets, or tubers – these may be divided in various ways, according to their habit. Special grafting techniques exploit the singular anatomy of eacti, making it possible to enhance flowering and improve growth rates of slow or difficult cultivars. Grafting also provides a means of perpetuating the exolic deformities of the

the exotic deformities of the monstrose, cristate, or neoncolored forms Raising species from seeds

s slower than vegetative propagation but is an easy and economical way to build up a collection It also helps conserve stocks of the increasing numbers of succulent species that are now endangered in the wild

MENICAN HAT PLANI
This succulent Kalanchoe
daigremontiana, produces
tiny plantlets at its leaf
in argins. In the wild
they would drop off and
root nearby. To propagate
these, carefully pick off the
plantlets and plant them in
it gritty cactus soil mix



# SOWING SEEDS

The majority of cacti and succulents are relatively straightforward to raise from seeds. Most germinate quite quickly if kept warm and moist and, although they are relatively slow-growing, it is interesting to watch the new plants develop. Most species are best sown in late winter so that the seedings are as large as possible before they become dormant in the following winter in colder climates, sow seeds under cover and use a closed case if possible. The seeds should germinate in spring when the warmer temperatures encourage plants to make active growth.

#### GATHER NG SEEDS

Commercial seeds are available, but gathering and sowing fresh seeds usually yields better results. Most cacti seeds are small and round but some, such as those of prickly pears (Opuntia), are large and have very thick coats, they may take up to two years to germinate. A few, such as those of Pediocactus, need a period of 2–4 weeks chilling in the refrigerator, at about 37°F (3°C), to trigger germination but these are the exceptions rather than the rule

If gathering seeds, take care to
let the seedpods ripen on the
plant; if harvested too early, many
of the seeds may not have developed
sufficently to germinate when sown. If
seeds need to be stored, keep them cool
and dry in a paper envelope. Sieve dry
seeds to remove any chaff, which could
cause rot later. Remove as much pulp as
possible from seeds of fleshy fruits, then
squash the wet seeds onto a paper
towel and allow them to dry.

Seedpods of succulents vary widely. Plants in the crassula family mostly have small pods, which become papery and dry when ripe; these contain tiny, dustlike seeds. Shake them out over a sheet of paper.

Mesembryanthemums
have buttonlike capsules that also turn
brown when ripe; moisien the capsules
to help them open and release the seeds
Euphorbias have pods with three
chambers, each of which contains one
round seed. When ripe, the pod
suddenly bursts to eject the seeds far
from the plant, to gather them, tie a
small paper bag over a ripening pod

Parameter Service Parameter Service Parameter Service Service



#### Types of sufdhead

Some dry seedpods split open to release seeds, while woody pods open when moistened by rain Others have fluffy "parachites", each plume is carried in the wind to distribute its seed. Seeds in fleshy fruits are eaten by animals and dispersed to he droppings — ready made seedbeds

#### SOWING SEEDS AND TRANSPLANTING SEEDLINGS



I fill the container here a 500 (13cm) pair to within our (1cm) of the bron with free-draining cachis seed soil mix. Firm lightly

Plasta bag prevents drying out



2 Sprinkle seeds evenly over the soil one surface by gently tapping the packet. If the seeds are this, meethem with fine sand first



Lunga de la water

1 1 15 7 7 7 11

James a. . . t

3 Use a fine mist-sprayer to hightly moisten for storage of the soil mix, making sure not or overvater or distant the soil is





Press each seed into the soil mix and sow at twice the seeds own depth. Space seeds about on (1cm) apart so they have enough more to devel p



4 Iop-diess with a thin layer of fine grit Label and place a clear plastic bug over the pot. Keep at a maximum temperature of 70% (21%) and in partial shade



5 Transfer the seedlings to a bright place at 59°F (15°C). When the seedanes are beginning to crowd each other carefully lift a clamp of them from the poi



6 Divide the clump into single seedings, keeping as much soil mix around the roots as possible see inser). Set each plant—to a 26m (6cm) pot of cactus soil mix.



Top-dress each pot with a on (5mm) layer of fine grit Label. Keep the pots at a minimum temperature of 59°F (15°C) and water sparingly after a few days

#### TRANSPLANTING SUCCULENTS



Vhen transplanting succulent seedlings there of Gasteria crouchert). Left them out individually from the seed tray. Take care not to domage their fragile roots or leaves.

#### SOWING SEEDS

The majority of cacti and succulents are quite slow to grow once they have germinated, so it makes sense to sow seeds in small containers to save space A 2in (5cm) pot is ideal for 25–30 seeds or a 5in (13cm) pan for 50–100 seeds, while a seed tray is large enough for 1,000 seeds

Sow the seeds as shown (see facing page). Use an open, free-draining soil mix to avoid rot. A specialized cactus soil mix is fine; alternatively, make a mix of one part very fine (Am or 3mm), sharp grit or coarse sand to two parts of potting mix, peat, or sterilized soil. The grit may be sold as bird grit in pet stores. Shell grit is too himy. Unless sterilized first (see p.33), vegetable matter, such as leaf mold, can contain fungal and bacterial spores, which introduce disease to seedlings.

Cover the surface of the soil mix and seeds with a shallow layer of grit to help keep the seeds in close contact with the soil mix and discourage rot as the seedlings develop. Sharp sand is used sometimes instead, but it is less suitable because it has a tendency to solidify and retain water and may also encourage algae and moss to develop

Water the seeds after sowing, either by spraying carefully (see facing page) or from below. Do this by immersing the container in a dish of water to about half its depth for about an hour, then remove it and allow it to drain. To provide the seedlings with protection against damping off (see p 46), add a general-purpose fungicide to the water

Put the container in a warm place, such as a closed case, but shielded from direct sun. Seeds in single pots may be sealed in clear plastic bags instead of a closed case. Keep at 70–86°F (21–30°C), depending on the species (see A–Z of Cacti and other Succulents, pp.242–51). Many types of seeds will germinate in 2–3 weeks; lower temperatures tend to extend this period. In hot conditions, above 90°F (32°C), germination is very poor, and the seeds will be dormant until the temperature drops.

Keep the soil mix fairly moist until the first seeds have germinated, then move them to a cooler environment, at a minimum of about 59°F (15°C). Once the seedlings appear, remove them from the closed case or plastic bags.

#### SEEDLING CARE

Keep the containers of seedlings in a warm, lightly shaded area. They should be watered regularly and not be allowed to dry out. Take care not to saturate the soil mix, however, because keeping the seedlings continuously wet will soon make them start to rot.

After germination, the seedlings will appear to do very little for 1–3 months while they develop their root systems. Many cactus seedlings will look like very small peas at about six months old. After this stage, they should double in size every three to six months, being about 1–2 in (2.5–5 cm) in chameter in 2–4 years after sowing. The tall species of columnar cactus usually grow more quickly than this

Small seedlings have a very delicate root systems that are easily damaged during transplanting. It is therefore best to leave the seedlings undisturbed for as long as possible until they become quite crowded, provided there are no other reasons for transplanting them, such as signs of an infection or any algae or moss growth on the soil mix.

#### TRANSPLANTING SEEDLINGS

After several months to two years, when the seedlings are large enough to handle comfortably, lift them from the container and gently tease them apart. Cactus seedlings have very soft spines and can generally be handled without protective gloves, but avoid touching and bruising their delicate roots.

Seedlings that are 1 in (2.5cm) or more in diameter should be potted into 2-2/in (5-6cm) pots. Smaller seedlings will grow better if planted in rows in seed trays or pans, spaced about twice their own diameter apart. They can then be grown on again until crowded before they need to be potted individually. In all cases, use a gritty cactus soil mix

After transplanting, allow seedings to settle and heal any damaged roots for a few days before watering. Place in a bright position, but keep out of full sun until the seedlings have established and show visible signs of new growth, then treat as adult plants. Small plants will benefit from protection from strong sun-



# DIVISION

Dividing cacti and other succulents is a relatively straightforward and fast way of obtaining new plants of a decent size. The technique is particularly useful for propagating hybrids, selected forms, and variegated plants, which are unlikely to come true from seeds

There are various methods of division, depending on the type of rootstock. Some plants form clumps of offsets, which develop their own root systems, others spread by means of underground stems or stolons, which produce plantlets a little way from the parent, carpeting or trailing species often root at intervals along the stems, and other succulents increase from tubers

The easiest way to decide how to divide a plant is to lift it or knock it out of its pot, shake off as much of the soil or soil mix as possible, and inspect the

roots. The basic principle for all division is to separate a vigorous plant into a few sections, each of which has its own roots

and growing point or shoots

Many succulents have fleshy roots which may easily rot if damaged during division and then allowed to stay wet. It is therefore wise to let divisions of plants settle in their new containers or positions for a few days before watering them, in order to allow any root damage a chance to heal

Dividing succulent rootstocks

Some clump-forming succulents with a crown of shoots, such as Sedim spectabile (syn Hylotelephium spectabile), may be treated as herbaceous perennials (see p 148). Divide a clump at the start of the growing season, as shown below making sure that each section has at least one healthy growing point and some healthy, vigorous roots

#### DIVIDING CLUMP-FORMING SUCCULENTS



1 Scrape away soil mix around the parent there Haworthia cymbiformis, to neveal the base of each offset. Detach an offset by cutting straight across the joint with the parent. Allow the wound to callus (see user)

DIVISION OF SUCCULENT OFFSETS

Many types of succulent form clumps by producing offsets around the parent plant. These usually develop much more quickly while attached to the parent, but periodically dividing the clump creates 'instant' new plants. The best time to divide most clump-forming plants is at the start of the growing season in spring or early summer (see also A–Z of Cacti and other Succulents, pp 242–51)

When dividing the plant, first hit it or remove it from its container and shake off as much soil mix as will come away easily from the roots. It is then easy to select and detach offsets that have already rooted, before replanting the parent and the offsets. Alternatively, take offsets from the perimeter of a plant without lifting it, as shown above



2 (2/m) pot with cactus soil mix and insert each cutting Top-dress with fine grit label, and keep in a warm spot in partial shak When new growth appears (see inser), pot on

Succulents such as Agave, Gasteria, and Haworthia are very easy to divide because their offsets usually have developed independent root systems and so make good growth once potted

Some large-growing succulents, such as certain types of Agave and Aloe, may produce large, densely rooted offsets that become difficult to separate from the parent. With these plants, you may need to use a sharp knife, pruners, or even back-to-back forks (see p.148) to pry apart a clump. Check the divisions for any loose or thin, discolored roots—these are often dead and should be removed. Untangle the remaining roots so that you can spread them out evenly in the new planting holes, or in the new containers if repotting.

Division of MAT-FORM NG SUCCULENTS
Some mat-forming or trailing members
of the crassula family, for example
Adromischus, Crassula, Sedum, and
some Echeveria, root along their stems
wherever they come into contact with
the soil to form a rooted mat

Established plants may be simply cut into smaller clumps with a sharp knife, the divisions may then be potted or replanted. By contrast, many of the carpeting mesembryanthemums rarely produce roots from their stems unless they are severed, so their offsets must be treated as stem cuttings (see p.236)

Dividing STOLONIFEROUS SUCCULENTS
Some succulents, for example some species of Agave, spread by thick, underground stems, or stolons, which run out from the base of the parent plant and end in a new rosette. Once the

#### DIVIDING SUCCULENT ROOTSTOCKS



I Divide the plant (here Sedum speciabile) as it comes into growth in the spring. Lift the whole plant with a fork, taking care not to damage the roots and fleshy leaves. Shake off as much soil as possible from the roots



2 Pull apart the plant into pieces, each with a root system about the size of a large hand Discard any woody, old growth from the center of the plant. Replant each piece, spacing show about 2ft (60cm) apart, and water in if dry

rosettes have developed a set of leaves they will normally have produced their own roots from the stem at the base of the rosette. It is best to leave very small shoots attached to the parent because they will develop much more quickly

Remove the older, rosette-bearing underground stems from the base of the parent plant with a sharp knife, then shorten them by cutting just beneath the new roots of the rosette. Allow the cut surfaces to dry in a warm, airy place for a couple of days before potting the rosettes individually

Other succulents that spread by stolons include members of Kleima and Senecto: divide these as for rosettes

Propagating Cactl From OFFSETS Most clump-forming cacti have just a single root system and produce offsets without independent roots, with the exception of very mature plants Unrooted offsets may, however, be cut off from the parent plant and treated as standard stem cuttings (see p 237) Some Echinopsis, Gymnocalycium, and Rebutia are exceptions, producing offsets with roots even when they are quite small Few clumping Manimillaria have rooted offsets, except for the very small-

headed species (see also A-Z of Cacti and other Succulents, pp 242-51) Epiphytic cacti cannot be divided

Offset-forming cacti are easy to divide by simply breaking up the clump into suitably sized pieces and treating them as succulent offsets (see facing page) Once potted, keep them at a minimum of about 64°F (18°C), and water them sparingly until new growth is visible

DIVIDING TUBEROUS SUCCULENTS

Some succulents increase from tubers. which are underground storage organs Tubers are sometimes produced on the fibrous roots of the parent, as with some species of Pelargonium Other succidents, such as Ceropegia, develop tubers just below soil level wherever the stems of the parent plant root into the soil

Most tuberous succulents have a dormant period, usually in winter. during which they often die back to the tuber. This is the best time to divide them, in most cases. However, many Pelargonium are dormant in summer, divide this group in late summer before the plants come back into growth Species that make active growth in summer (usually those from regions with summer rainfall) are best divided

in spring. Divide deciduous Ceropegia in spring, evergreen types at any time the weather is warm, ideally in late spring Juberous Senecio and Kleinia should be divided in spring or summer

Divide stem tubers, such as those of Cempegia, as shown below. Make sure that each tuber has at least one shoot or growing point. To divide root tubers, simply lift the plant and pull away some healthy tubers. If the rootstock is very dense, cut through the roots to avoid tearing the tubers. Pot immediately, as for stem tubers (see below), but cover the tubers with a thin layer of soil mix

Some of these tuberous plants may be difficult, so care is needed to reestablish them successfully. It is particularly important not to overwater the soil mix, because this can lead to rot

#### DIVISION OF PLANTLETS

Some Pelargontum, such as certain scented-leaf forms including the rosescented geranium (Pelargontum graveolens), produce plantlets along their rootlike stems. In open beds, the plantiets can become invasive, so they are easy to propagate. Sever the stems between the plantlet and the parent, lift, and pot singly as for tubers

#### DIVISION OF TUBERS



I in late spring to summer, dig out some mature tubers wach with a woodu). Allow to dry for a few days in a bright, warm, and airy place.



one tuber in a pot, make sure that they are not touching

🔿 F II a 3in (8cm) pot with griffy, free-draining cactus soil in a to within in (lent) of the ron bisert each tuber's that its mots are buried in the mexand the taber sits on the surface. If planting more than



Top-dress with a layer of fine gravel around the tuber Label the pot, and water lightly Place in a bright, airs position, out of direct sunnight, and at a mimmum temperature of 61°C (16°C) Water sparingly, keeping the soil mix only slightly moist until the tuber sends out new shoots this is usually in 2-3 weeks)

## TAKING CUTTINGS

Come cacti and other succulents do not flower readily in cultivation, and commercial seeds are often not readily available, so taking cuttings offers a reliable way of increasing many of these plants. Succulent cuttings have the advantage that, because of their fleshy tissue, they can retain nutrients and water while they become established

Unusual forms, such as variegated, monstrose, or cristate (crested) plants, and hybrids, can usually be propagated only from cuttings to preserve their distinctive characteristics

There are various types of cuttings, the most suitable depending on the plants form and growth habit. Succulents are generally propagated by stem, leaf, or rosette cuttings, while cacti are raised from globular, columnar, or flat stem cuttings. Many clump-forming species produce unrooted offsets, which may also be treated as cuttings.

#### SELECTING SU TABLE MATERIAL

When selecting cuttings, you will increase the chances of success if you take care to choose suitable material from the parent plant. Take cuttings from tissue that is semi-ripe or ripe rather than very young, cuttings that are very small, or taken from immature tissue, are more prone to rot. On the other hand, cuttings that are too large (with the exception of some of the columnar eacti), or from material that is old and woody, take a long time to root

In most cases, remove material for the cuttings using a sharp knife. It is important that knives and surfaces are clean (see p.30) to avoid introducing disease through the cuts. With some leaf cuttings, however, it is better to pull off the leaf. Once you have taken a cutting, allow the cut surface to form a callus by leaving it in a warm, dry

TAKING SUCCULENT STEM CUTTINGS Cat straigh. Tron the shoot te

I in early to midspring, choose La healthy sideshoot there of a Kalanchoe) Using a clear sharp hinfe, make a straight cut as close to the base of the stem as possible

about 2m (5cm) long, removing the leaves from the bottom sur (Lonof stem if necessary Leave the cutting in a warm, dry place for about 48 hours to allow R for courts

Prepare a 301 (8cm) por with gratty soft into (see below). Insert the cutting into the gric top-dressing so that the leaves are just clear of the statuer

for dress with layer of four gen

arry place. This may take up to several days, depending on the thickness of the cutting and on the time of year

#### SUITABLE ROOTING MEDIA

A suitable rooting medium for cactiand succulents would consist of two parts cactus soil mix to one of fine grit With succulents, it is important that the cuttings have just enough moisture to encourage rooting without being wel, which will quickly rot them. Using soil mix with a layer of fine grit or fine gravel on top allows any excess moisture in the mix to evaporate through the gravel, providing enough water for rooting while leaving the base of the cutting comparatively dry. Similarly when polling a culting, insert it into

the soil mix just deep enough for it to stay upright, if too deep in the mix, the base of the cutting may rot before it has rooted

#### SUCCULENT STEM CUTTINGS

Most small slender-stemmed succulents with a bushy habit, especially those in the crassula family, root easily from cuttings. They are prepared in a similar way to herbaceous cuttings (see above and p. 154). Larger cuttings are treated as for cactus stem cuttings (see p.238)

Take the cuttings from stems that have ripened and lost their bright, juvenile color, as shown (see above) Trim the cuttings so that they are 2-3iii (5-8cm) in length. Longer cuttings tend to collapse and bend during rooting and do not make good plants. Allow the cuttings to callus so that they form hard skins over the wounds

Take a pan or seed tray and prepare it as shown (see left). Gently push the cutungs through the fine grit into the soil mix. Keep slightly damp; many will root in one to three weeks if kept warm. Succulent cuttings are much more prone to damping off (see p.46) in high humidity, so do not place them. in a closed case. If the conditions are not warm enough, apply gentle bottom heat of 70°F (21°C)

#### SUCCULENT LEAF CUTTINGS

Some types of succulent, for example many species of Crassula, Kalanchoe, and Echeveria (all members of the crassula family), may be propagated



Fine girt

Gritty cactus soil mey

POT PREPARED FOR CLITTINGS Cacta and succulent cuttings root most successfully in a free-draining soft mix Use a pot three-quarters filled with a gratty cactus soil mix and topped with fine grit. The top-dressing will protect the stem of the cutting from rot, while the base of the cutting roots into the soil mix

#### TAKING SUCCULENT LEAF CUTTINGS



1 Remove a macro-cealdry teer

The 1 Pactop of the willer in

by pulling it gently sideways pact the seco.

All my the wound to cathes (see inset) by leaving the leaf for a few days in a worm, dry piace.

from leaf cuttings. Many of these plants have their axulary buds (those in the axil of the leaves) more firmly attached to the leaves than the stems. The buds are not generally visible, but by gently easing a mature, healthy leaf slowly sideways from the stem, it should come away with the axillary bud attached.

Take the cuttings, selecting firm, fleshy leaves, and pot them as shown above. Place them in a bright position but shielded from direct sun, and keep them slightly damp. The minimum temperature requirement varies according to the species (see A–Z of Cacti and other Succulents, pp. 242–51)

The leaves should start to produce roots after two to four weeks. After a month or more, tiny new plantlets will develop around the base, usually in clusters. When these are large enough to handle, split them and treat as succulent stem cuttings (see facing page)

Leaf cuttings will also often root on damp newspaper. Simply fold a sheet of newspaper and place it in the bottom of a seed tray. Spray with water and drain off the surplus. Lay the leaves on top, then keep in a bright, airy place; spray with water occasionally. When the leaves form roots, pot them as shown above

#### SUCCULENT ROSETTE CUTTINGS

Some rosette-forming succulents, such as Echeveria, Haworthia, and Sempervivum, consist of clumps of rosettes. These rosettes may be severed at the base where they join the parent plant, and rooted as shown (see right)

WHEN TO TAKE CACTI STEM CUTTINGS

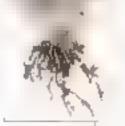
The best time of year to take cuttings of most cacti, especially in colder chimates, is in late spring when the warmer, drier weather arrives and the plants have started to grow strongly. It then gives them a chance to establish for as long as possible before the following winter



2 Prepare a 5in (13cm) pan (or a seed tray)
with gritty soil mex and fine grit (see facing
pass. I ish the base or each heat deep enough
into the grit for the leaf (13stand up Space the
cuttings about 15in (14m) apart



3 Label and place in a bright warm, arry position. Keep all his moist. After 1-6 months, the testing should have took lated peaking drives practicly some lated.



L'sing a clean Sharp knife, cui

2-3m (5-8cm) from

insette of leaves there

of Echeveria Frosty's

from off the bottom

and allow to callies

leaves (see tilset

for a few days

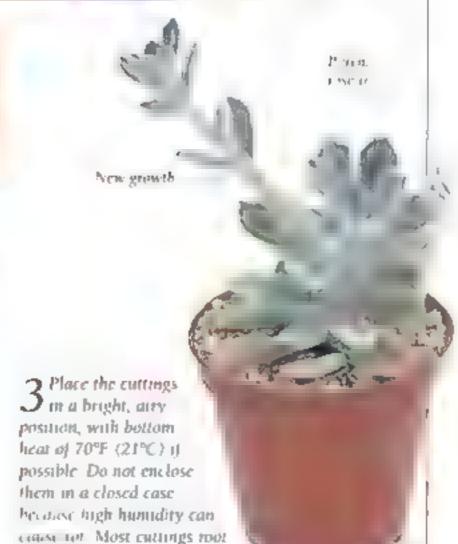
the top of a young

#### SUCCULENT ROSETTE CUTTINGS





Prepare a standard 3in (8cm) pot (see facing page) or a deep seed tray. Gently push the stem of the cutting through the fine grit top-dressing into the soil mix below, so that the leaves sit just above the surface. Label the pot



within 1-3 weeks

#### TAKING FLAT STEM CUTTINGS



Lepiphyllum, into 9in (23cm) sections with a clean, sharp bridge Atlow them to catlas for a few days in a warm, dry place. Fill a pot the smallest one that a cutting will stand up in) one-thard full of cactus soil mix.

#### GLOBULAR STEM CUTTINGS

Many globular cacti such as Echinopsis and some Mammillaria produce offsets that may be detached and treated as cuttings to make extra plants, although they usually look more attractive when grown on as large clumps

Take a cutting by easing a sharp knife between the offset and the parent plant Cut through the base of the offset at its narrowest point. Allow the cuttings to callus for two days or more.

Prepare a pot or seed tray in the usual way (see p 236). Gently push each cutting down into the grit until it touches the soil mix. Place in an airy spot at about 70°F (21°C), and water sparingly. The cuttings should root in three weeks to three months.

#### COLUMNAR CACTI STEM CUTTINGS

Most types of columnar cacti, and some Eaphorbia and Stapelia, may be grown from stem cuttings, it may be necessary to use the main stem because many of these plants do not branch until mature Cut a section from the top of a stem as shown (see right). Leave in a dry, airy spot to callus. In summer, this may take only a few days, but at other times of the year it may take considerably longer

Pot the cutting as shown, filling in around it with fine gravel to hold it steady. Water sparingly to keep the soil mix from drying out completely. This heips to reduce the risk of rot, because the base of the cutting is not in contact with wet soil mix. The moisture evaporating from the mix is trapped in the gravel, encouraging rooting.

Leave the pot in a bright and airy place at a minimum of 64–75°F (18–24°C), depending on the species The cuttings should root in 3–12 weeks.



2 cover the soil mix with a shallow layer of fine grit, then push the cutting into the mix below fill the porto just below the rim with more fine grit to support the cutting. Make sine that each cutting is planted with the end that was nearest the parent plant in the pot



3 Label and keep in a bright spot but out of threet sion, at a temperature of 64–75°1 18–24°C.) Occasionativ must spray with water bia do not overwater, because this may make the cuttings rot. The sections should root in 3–12 weeks, depending on the piant and season

#### TAKING COLUMNAR STEM CUTTINGS



I the top of the plant there behanopsis pachanor), from 3in (8cm) to 6ft (2m) long depending on the size of the plant. True the base and allow to callus (see inset) for 1-4 weeks

When the cuttings are showing signs of active growth, tip the pot sideways to remove the gravel, and replace it with soil mix. Once the plant has developed a good root system, it may be potted into a larger container that better suits its proportions

#### FLAT STEM CUTTINGS

Some epiphytic (forest) cacu, such as Epiphyllum and Christmas cacti (Schlumbergera), usually root easily from sections of their flat, leaflike stems. These cacti generally prefer a more humid



2 Use the smallest pot that the cutting will stand up in Fill the bottom Int (2.5cm) with cactus soil mix then a in (1cm) layer of fine gravel. Stand the cutting on the gravel. Full with gravel label, and water lightly

environment than desert types, and they prefer partial shade

In late spring or early summer, after flowering, remove a whole, mature stem from the parent plant at the base, and cut it across its width into sections (see top of page). Allow the cuttings to callus for a few days. Prepare a pot as shown, then carefully push each cutting about 1–2m (2.5–5cm) through the grit into the soil mix. Up to about ten cuttings, spaced evenly apart, may be rooted in a 5m (13cm) pot. Keep slightly moist in a warm, shady position until rooted

# GRAFTING

This process involves propagating a plant by taking a cutting (the scion) and uniting it with the base (the rootstock or stock) of a more vigorous species. While it is relatively easy to graft many cacti, most other succulents are more difficult to treat in this way. The fundamental principles are the same, but specific techniques vary according to the plants used. The best time of year to carry out grafting is at the start of the growing season, from late spring to midsummer.

#### REASONS FOR GRAFTING

FLAT GRAFTING

When grafted, many slow-growing and difficult species become easier to cultivate and flower more readily; in some cases, growth rates increase by as much as ten times. Plants that do not grow well on their own roots outside their natural habitat, or that grow so slowly from seeds that they are almost impossible to increase in this way, are best grafted

Grafting is used to propagate unusual cacti such as the cristate (crested) or the monstrose forms, as well as cultivars that have been bred without chlorophyll, such as the neon cacti. A plant lacking

chlorophyll cannot manufacture any food for itself, so it is grafted onto a green stock, which supplies nutrients for both the stock and scion

#### How graffing works

The stems of many cacti and other succulents possess two principal types of tissue, the xylem and the phloem separated by a concentric ring between them (see box, p 240). This ring is the cambium, which in old stems may be woody. Inside the ring is the xylem, which conducts nutrients and water through the plant from the roots. On the outside is the phloem, which stores sugars and water and deals with waste. products. Xylem, cambium, and phloem together form the vascular bundle. For a graft to unite successfully, the xylems, cambiums, and phloems of both stock and scion must be in contact

#### SUITABLE ROOTSTOCKS

Most grafts must use a rootstock and scion from within the same plant family. To increase the chances of success, both stock and scion should be healthy and growing well. With a little practice, you

may expect a success rate of over 90 percent. However, many growers resort to this method only to try to propagate a plant that is already ailing, in which case a success rate of 30 percent or less is more likely. Generally, a fast- and easygrowing plant is used for the stock

For cacu, a three-sided Hylocereus species is often used commercially as a stock. In warm areas, it is ideal for rapid growth, but it needs a winter minimum of 59°F (15°C), higher than many people keep their collections in colder chimates. The talter Echinopsis species (formerly Trichocereus), such as Echinopsis pachanoi, & scopulicolus, and E spachiana, are robust and easy to grow, and so make much better stocks for cold chimates.

#### FLAT GRAFTING

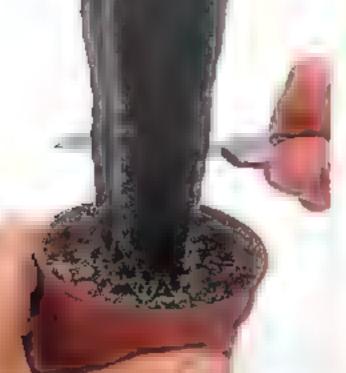
This is by far the most common type of graft, because it is easy and quick to use and generally gives excellent results. For grafting, you need a sharp knife with a blade that is rigid enough not to bend but thin to make the cut as cleanly as possible and avoid crushing the cells on either side of the cut. There are many cheap, disposable (continued on p. 240)



2 Using the knife, chamfer the edges of the stock. This is done by trimining off each of the corners, making a diagonal cut upward about sin (5mm) below the cut surface. Do not touch the wound with your hands.



3 lake a stem cutting from the scion plant here Rebutta campuerain [ rauselin) that is 2-1in (1-2 5cm) in diameter and no taller than it is broad. If the skin is very tough chamfer the edges a little



In tate spring to midsummer, cut straight across the top of a vigorous stock plant (here Echinopsis scopulatolus) using a caranthin biaded kmfe Leave a 1-2in (2 5-5cm) tail rootstock in the pot



Place rubber bands at right angles

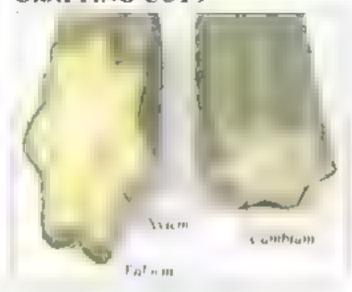
A Place the seton
on the stock
and gently "screw"
the two surfaces
together. This
ensures that any air
bubbles are eliminated
and the exposed tissues
are in close contact
Secure in place with
two rubber bands. Label



Grafted plant after 6-12 months

5 Leave the pot in a bright arry place out of direct sunlight keep the soil max slightly moist Remove the rubber bands when there are signs of active new growth, usualty after about two weeks

#### GRAFTING CUTS



A straight cut made across the stem wift expose sufficient amounts of the different types of tissue in a thick-stemmed cactus for flat grafting (see above, right). Using an angied cut (above, left) exposes a larger area of tissues, which increases the chances of a successful union when side grafting species with stender stems

(continued from p. 2.39) craft knives or scalpels available that are all excellent for use in graining. Make sure that you have everything on hand before you start, and work quickly to complete the operation with as little contamination as possible. Sterilize the kmfc blade by standing it in alcohol or denatured alcohol (see also p 30)

Cut down the cactus that you have selected for the rootstock (see p 239 and box, below), and prepare it as shown (see page 239) Bear in mind that short stocks usually look much better than tall ones. When you have made the cut, make sure that the vascular bundle, xylem, and phloem are all exposed

and cutting the stock too near the tip of the stem may leave the growing point intact - with disastrous results. The tip of the stock will continue to grow through the scion and will overwhelm it. If the stock has a hard skin, chamfer the edges a bittle so that when the tissue shrinks it will not become concave and pull away from the scion. Now quickly prepare the scion (the

Some cacti have sunken growing points,

plant you want to propagate). Cut the base cleanly and, if it has a very rough skin, chamfer the edges as for the stock Position the scion on top of the stock, make sure that at least part of the xylem and phloem of the scion matches up with those of the stock. Once you have joined the scion and stock, lightly rotate ("screw") the scion to expel any excess sap or air bubbles, then secure in place

There are various ways of holding the two cut surfaces together with a little pressure until they have united Broad rubber bands are ideal for small grafted plants in pots, but check that they are not so light that they cut into the scion

Larger cactus grafts or those growing in open ground may be held together. using an old piece of nylon stocking, stretched into a rope. Hook one endover the spines on one side of the stock, take it over the scion, then pull it tight and hook the other end to spines on the other side of the stock. Alternatively, apply the required pressure by using two lengths of string, weighted at the ends, draped over the scion at right angles

Place the newly grafted plant in a bright, airy position at 66°F (19°C), shielded from full sun. The graft should unite in two to three weeks. Water the

stock, useful for small scions

commercial growers grafting in high

plant according to the stock plants requirements, but try to keep water away from the cut surfaces. Signs of active new growth will soon be apparent if the graft is successful, after which you can remove the ties. Grow the plant for about a month in light shade, then treat as normal

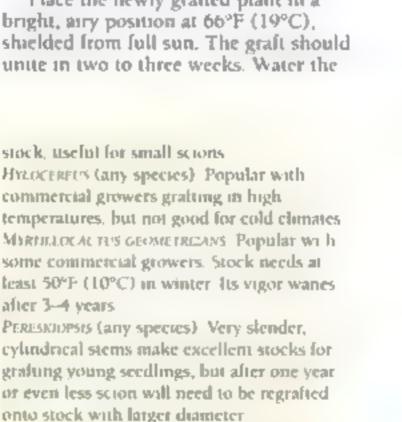
#### SIDE GRAFTING

This technique is used for grafting slender-stemmed species, such as Echinopsis chamaecereus, or those with a narrow central core, which makes it difficult or impossible to carry out a conventional flat graft. Cutting a slender-stemmed scion at a shallow angle so that the cut surface is a long oval (see box, far left) provides a larger

SIDE GRALTING Make an obtique cut on the stock and scion and press the cut surfaces together Secure with a cactus spine or clean needle and bord with raffia or ribber bands. Support the grafted plant with a thin stake and twine Ireal as for a flatgrafted plant Cacatas spine

Kaldare

budd

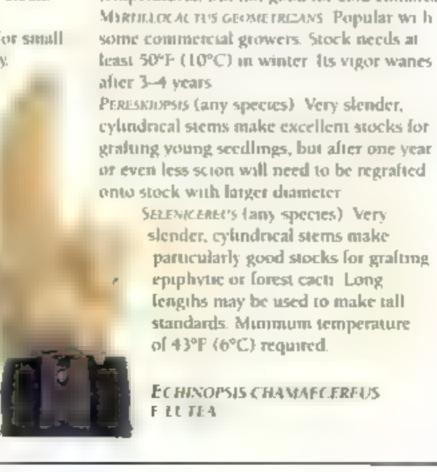


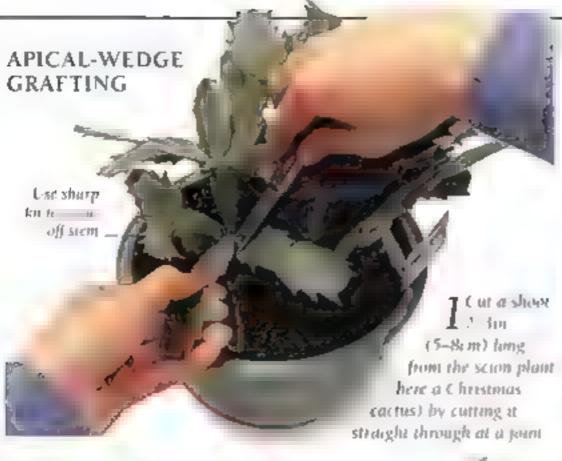
SELENICEREUS (any species) Very slender, cylindrical stems make particularly good stocks for grafting epiphytic or forest cacti. Long. lengths may be used to make tall standards. Minimum temperature of 43°F (6°C) required.

ECHINOPSIS CHAMAFCERFUS FECTEA

POPULAR ROOTSTOCKS FOR GRAFTING CACTI

In theory, any cactus may be grafted onto any other type of cactus, but the following are the more popular rootstocks CERPUS (any species). Short-lived as stock. tending to last only 3-5 years CLESTOCACTOS WINTER! Quite good for small growing plants, but may offset freely. Echnopsis (most species) Ideal as stock in colder clanates. Tall growing species (syn-Trichocercus) are easier to use than globular ones. E pachanor and E. scopulicolus both give sturdy and robust growth. Stock is slow to offset and tolerates temperatures as low as 45°F (7°C) E. spachianus is also popular, but offsets freely EMPHYLLUAT HYBRIDS New growth (cyandrical or four-angled) is useful for small seedling scions. Stock has hanted useful life HARRISIA (any species) Slender







Cut the top 1 3m (2.5 No. ) La from a steer on the stock plant \* in a Selenicereus) Make a fine sertical cut on (2cm) deep in the vascular hundle

Put a weakened clothes po-

Docross the secto hold the graft

formly to place. Label and leave to

partial shade. Remove the pin and



BINDING A GRAFT

WITH RAFFIA

You may prefer to use raffin to bind the graft instead of the cactus spine and clothes pinshown in step 5. Do not tie the raffia ton tightly, or it may crush the tissue of stock and secon



Tese a thin bladed haife to pare I shivers of skin from both sides of the base of the scorn to form a e peed end. Make sure that the central core is exposed.



4 the top of the stock so that the exposed tissues of both as in close ont tel. Push a long eactus spote through the grafted area

## spine one; the graft has united

APICAL-WEDGE GRAFTING This technique, which is also sometimes known as split grafting, may be used instead of a flat graft, but it is difficult to cut the stock and scion at exactly the same angles so that they match up well. It is therefore usually reserved for those cases where a flat graft would be unsatisfactory and is especially suitable for each with flat, leaflike stems and other epiphytes, as well as some slenderstemmed succulents. Like side grafting. this method is also often used to create a standard, using scions such as the Christmas cactus (Schlumbergera)

For the rootstock, use a slender plant such as Pereshiopsis or Scienicereus grown to the required length. Tie in to a sturdy stake for support. Take a cutting one or two stem segments long from the scion plant. Two scions may be grafted. back to back onto the same stock this produces a plant with a well-balanced head more quickly than a single scion.

Prepare the stock and scion(s) as shown above. When inserting the scion into the top of the stock, take care to match the cut surfaces as closely as possible. Secure the scion in place and apply light pressure by clamping the graft with a weakened clothes pin or by binding it with raffia. Place the grafted plant in an airy position, out of full sun, at 66°F (19°C). Water as normal for the stock plant. The two plants should unite

within a few days GRAFTING OTHER SUCCULENTS

Although exactly the same methods are used, grafting succulents is generally far more complex than grafting eact. Both seion and stock should be from the same plant family, but because of the huge diversity of most of these families, some stocks may be compatible with the scion, while others are not. As with eacti, use a stock from a plant that is easy-growing and vigorous. The following scions and stocks generally may be grafted successfully ADENIA. The more difficult and rarer. species are grafted onto Adenia glauca ADENIUM New color hybrids are grafted. onto Adenium obesum, and rarer species onto oleanders (Nertum) CERARIA These may be grafted onto Portulacaria afra CEROPEGIA, STAPELIA Scions of these are grafted onto Ceropegia linearis subsp woodti and Stapelia grandiflora EUPHORBIA MONADENIUM These are usually grafted onto one of the cactuslike species such as Euphorma ingens and E. canamensis PACHIPODIUM Madagascan species may

be grafted onto Pachypodium lamerer

area of xylem and phloem to unite with those on the stock. The scion may then he secured in place as on a flat graft, with gentle pressure applied by using rubber bands, the resulting grafted plant is very one-sided, however, and so is not particularly pleasing

The better option is to use a more slender stock, such as of Pereskiopsis or Sciencereus, and cut both the stock and scion diagonally. As when flat grafting. check that parts of the xylem and phloem correspond, and "screw" the scion gently onto the stock to expel any air bubbles. It may not be practical to secure the graft with rubber bands, so hold the scion in place on the stock with a cactus spine (as shown, left) or a clean needle, then bind them together with raffia or a rubber band or clamp them using an old clothes pin that has a weakened spring.

Side grafting is an ideal method for producing a tall standard plant with a treelike stem, such as for the rat's tail cactus (Rhipsalis), allowing room for the long stems to trail (see p.250). Root a plant of Selenicereus up to 4ft (1 2m) in length, once it is growing actively, it is ready to use as a stock. Secure the stock to a sturdy stake to keep it straight and help support the weight of the graft, then side graft a Rhipsalis scion onto it.



# A-Z of cacti and other succulents

## **AEONIUM**

SEEDS in early spring of in autumn \( \)
CUTTINGS in spring of in autumn \( \)

Many of the plants in this genus (syn Megalonium) tolerate dry cold to a minimum of 50°F (10°C) but rot in damp conditions. Mature rosettes and in some cases the entire plant may die after flowering. Species that are predominantly solitary, such as Aeonium tabuliforme (syn. A bertofettanum, Sempervivum complanatum) and A spectabile, can usually be raised only from seeds. Cuttings may be taken from any plant once it is large enough.

#### SLEDS

Aconium seeds are minute and dustlike even a small pinch will produce hundreds of seedlings if the seeds are fresh and viable. Viability of stored seeds rapidly declines to only one or two percent. The tiny seedpods are papery when ripe in summer. To sow the seeds, mix with a little fine sand and sow (see p. 232) to germinate at 66–75°F (19–24°C).

#### CUTTINGS

Take cuttings while the plant is in active growth. Some of the taller species with sturdy stems, such as A. arboreum (syn Sempervivum arboreum), lend themselves to propagation from large stem cuttings (see right and p 236). Cut each stem 3–12in (8–30cm) below the leading rosette; the more rigid the stem, the longer the cutting may be

Once the cuttings have callused set them individually, 2–3m (5–8cm) deep, in fairly small pots of gritty cactus soil mix. Keep just moist. Cuttings taken in spring or early autumn root rapidly in 1–2 weeks and make good-sized plants in 1–2 months.

Treat cuttings that have slender stems such as A. sedifolium (syn. Aichryson sedifolium, Sempervivum masferreri) and A. haworthii (syn. Sempervivum haworthii), as rosette cuttings (see p 237). Although it is a member of the crassula (amily this succulent does not root from single leaves



ABONILM STEM CLITTINGS

Take a cutting there of Aconnan arbonium

s x ring the sten at least 301 (8cm below the
leading resette. Aflow to callus for 1-3 days. Pot
in her is printing that ar off any sidesboots at
the open, short and the distribution is at

## **AGAVE**

SEEDS OFFIS A SEED OF THE SEEDS OF THE SEEDS

The hardier members in this genus tend to have bluish leaves, more tropical, light green-leaved or variegated cultivars are slightly less hardy. They tolerate a minimum of 41–50°F (5–10°C) depending on the species. Some are monocarpic, dying once they have flowered, with other species, each rosette dies after flowering. Agaves are easy to raise from seeds, if available Most species offset readily, lending themselves to division

#### SELDS

In cultivation, they set seeds rather erratically, hand-pollination may help (see p 233). If fertilized, they produce seed capsules that swell as they ripen. When sowing the large, flat seeds (see p 232) at 70°F (21°C), cover them with a Ain (5mm) layer of fine grit to keep them in contact with the soil. It takes 2–3 years to raise a small plant.

#### DIVISION

Agave increase by underground stems, or stolons, from which new rosettes, or offsets, are produced. Wait until each

offset has a complete rosette of leaves, by then, it should have its own root system. These plants have vicious spines and daggerlike teeth, so it is advisable to wear protective gloves and sleeves when handling them. Divide young plants as shown below for good plants in 2–5 years. Keep each division just moist until well established, usually in 1–3 months.

Mature plants of species that freely offset, for example A. americana (syn A. altissima) and its cultivars, soon make large, tightly packed clumps. These may be divided with a knife into smaller sections or individual offsets (see p. 234)

#### DIVIDING AGAVE OFFSETS



1 dt or knock out the parent plant (hen Agave americana 'Vorsegota') and lay on its side so you can reach below the spiny leaves. Remove the loose soil and oid or dead roots.



3 Select a L nealths is and separate it non-the parent cutting through the connecting stolon with a clean, sharp write first below the offsets roots Replant the parent Place the Hset in a warm bright, arry spot for a few days until the wound allies s net



3 Pot the offset in gritty caches soil mox Top dress with a shahow laver of small gravel. Do not water for the first week

## **ASTROPHYTUM**



Astrophytum

or ridslightd

SEEDS in spring or summer 11
GRAFTING in late spring t
late summer 11

The entire genus may be relatively difficult to propagate because they are slow-growing and have poor root systems Adding calcium (for

example in the form of hine) to the soil or soil mix aids growth of new roots These cach tolerate a minimum of 50°F (10°C)

Seeds germinate easily, often in 4–5 days, if fresh and sown at 70°F (21°C). They are helmet-shaped and produced in red or green fruits. Unusually, viable seeds do not sink when placed in water.

because they contain air pockets. Before sowing (see p.232), liberally sprinkle the surface of the soil mix with ground lime, this greatly increases the survival and growth rate of seedlings

The sand dollar cacius, Astrophytum asterias (syn. Echinocacius asterias), is prone to rot if too wet and to shrivel if too dry; it grows better if grafted as a seedling. The slender, young stems of Pereskiopsis make ideal rootstocks

When grafting, as shown below, it is essential to work quickly and unite each scion and stock before the sap dries up. This happens after 15–30 seconds. The stocks may produce suckers later on, remove these as soon as they appear. Plants reach a good size in 2–4 years.

## **CEPHALOCEREUS**

SEEDS in spring []
CUTTINGS from spring to summer []

These cactt, hardy to 50°F (10°C), are fairly rare in cultivation apart from the old man cactus (Cephalocereus senilis). Plants may take ten years or more to reach 12 in (30cm) in height and 50 years to reach 5ft (15m). Because of their slow growth and usually solitary stems, they are normally raised from seeds. Taking a cutting is worth doing only to save a plant that has rotted at the base. Most benefit from additional time in the soil or soil mix.

#### SEEDS

Use a very free-draining soil mix of two parts cactus mix and one of fine grit because these cacti are very susceptible to overwatering. Sow the seeds (see p.232) at 66–75°F (19–24°C)

#### CUTTINGS

If taking a columnar stem cutting, cut the stem above the site of the rot and inspect the cut surface. If there is any discoloration, trim the cutting until the tissue is clean. Allow the wound to callus for 2–3 weeks until it is firm and dry. Pot into fine gravel and water sparingly only in warm weather until active growth is visible; this may take up to two years.



OLD MAN CACILS The spines on this species, C sembs. become longer rota titicker as d mat mes (sec. le(t) It will not hower or fruit control of the totago vears old or Enong Stell N generally granyn from parchased speils

#### GRAFTING ASTROPHYTUM SEEDLINGS

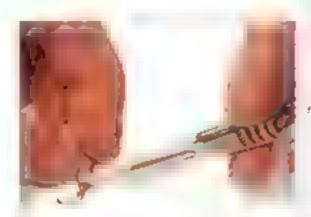


For a seedling graft a suitable footstock stack as a 4-6m (10-15cm) tall Pereskiopsis spathulate and Astrophytium scedlings (here footstock by cutting it book to about 1-2m

about 1-2m

\* i=5cm) and

tromming off
the sideshoots



2 in mediately after the rootstock is prepared lift a seeding to use as a seen. I se a sterilized scalpel of a sharp, thin bladed limit to cut off the roots at the base. Work is quickly as possible.



3 Gently press the prepared scion onto the top of the stock to one side so that as much of the water storing tissue and central transport tissue are aligned as possible. Rotate the scion gently to remove any trapped an bubbles, the sap should hold it in page.



A Place the grafted plan in a humid chamber here a boule clocks over a saucer with a little water. Keep at a minimum of 70% 21% ) in bright indirect light. The graft should show signs of active growth in 2~3 weeks (see inser-

#### OTHER CACTI AND SUCCULENTS

ADEMIA Sow seeds (see p 232) in spring at 66–75°F (19–24°C) 1. Take stem cuttings (p 236) in summer 111. Apical-wedge graft (p.241) rare or difficult cultivars onto A glauca stocks 11. Ademit M obest M (syn A. drabicum A. micranthum A. speciosam) Seeds (see p.232) at 61°F (16°C) in spring 11. Flator side graft (pp 239–41) rare or

colored cultivars on species [1]
ADROMISCHES As for Crassina
(p 245) [
AICHROSON Sow seeds (see p 232)
in spring at 66-75°F (19-24°C)
[1] Take rosette cuttings (p 237)
in spring or early summer [
ALOE Sow seeds (see p.232) at
70°F (21°C) in spring to autumn
[1] Divide offsets (p 234) just
before season of growth in

spring or autumn ‡ Take cuitings as for Gasteria (p.247) ‡. Apostocactus Sow seeds (see p.232) at 70°F (21°C) from spring to summer ‡. Cuitings as for Epiphyllium (p.246) ‡. Argaeobersta As for Haworthia (see p.247) ‡. Argaeappers Sow seeds (see p.232) from spring to summer at 15°F (24°C) ‡‡‡. Graft seedlings

as for Astrophytum (above) 1.
Browningia (syn Azureocereus)
As for Cereus (see p.244) 1.
Carmmanth i m. As for Cereus (see p.244) 1.
Carnegla Gigantea Seeds at 70°F (21°C) in spring (p.232) 1.
Cerualophyticm (see p.245) 1.
Ceraria Seed and stem cuttings as for Cotyledon, p.245) 11.

## **CEREUS**

SEEDS in spring of in summer !!
COTTINGS in spring of in summer !!

These mostly tall columnar cacti are easy to raise from seeds. They grow up to 4ft (1 2m) a year and branch freely so a single cutting will give a decent plant almost instantly. Certus tolerate short periods of 25°F (-4°C)

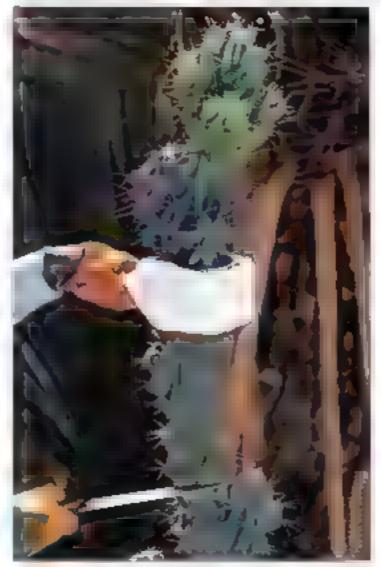
#### SEEDS

The flowers open at right and are pollinated by moths. Hand-pollinate plants grown under cover (see p 233). Allow the plumlike fruits to ripen and soften before extracting the dark seeds. Sow (see p 232) at 66-75°F (19-24°C) for good-sized plants in ten years.

#### CUTTINGS

Because the columnar stems are rigid it is possible to take cuttings up to 6ft (2m) long. The monstrose form of Cereus hadmanatanus (often mistakents called C peruvianus) is best increased by cuttings (see right and p 238), although it reproduces fairly readily from seeds. The larger the wound on the cutting, the longer it takes to callus. After poining keep the soil mix slightly moist in warm weather. Cuttings root in 1–12 months.

#### TAKING A CEREUS STEM CUTTING



1 Wear thick gloves and wrap a folded cloth around the chosen stem (here a monstrose form of Cereus haldmannianus) to steady it I so a large kinde to remove a 301-3ft 8016-116 length cutting straight across the stem

Paler green tip is current season's growth



2 Place the cutting to wac one to a styroloom blocks to prevent the spines from being damaged. Leave it in a warm, dry place to affew the cut surface to callus. This will take at least 2-3 weeks in summer and a bitle tanger at other times of the year.



3 choose a pot that is slightly larger than the base of the cutting I il the pottom that was cactus soid max, then and a 1th (2 5cm) tayer of fine gravel. Stand the atting on the gravel and fill around it with more gravel to the top II necessary, support it with one of a me stiady stakes. Label and heep the soil in x slightly mass.

## CEROPEGIA

Seeds in spring [

Division to an spring to summer Lestern tubers 111 (rom tubers)

CUTTINGS from spring to summer (1) (sheld) to some 1 to trubing or teating species

The many succulents in this genus grow best with a minimum of 39–64°f (4–18°C). When sowing seeds (see p 232), cover them with fine grit to ensure moist conditions for germination. Most germinate rapidly at 75–81°f (24–27°C). Fresh seeds often germinate in less than a week.

Most tuberous species produce offset tubers at the roots of the parent tuber. Lift the plant, remove the offset tubers, and pot, for new plants in 2–3 months. Detach tubers that form along the stems without lifting the parent (see p 235).

To propagate sticklike species such as Ceropegia dichotoma, take 4-6in (10-15cm) cuttings with at least three

#### STEM CUTTINGS OF TRAILING CEROPEGIA



I three quarters fill a Sin
the party decourses
that igs soil mix Loosely coil
a test on 2 interior angue
of stem peg it on the surface

bases touch the soil mix

nodes, severed just below a leaf node

scar Pot as stem cuttings (see p 236) to

root in 1-2 months, but do not let the

Take stem cuttings also from slender-

stemmed, chibing, and trailing species,

NICCUSETIA

2 Cover with oin (lent) of year one I had an in the property of the property o

3 Once the new shoots are 4 out (10-15cm) t dl cut the stem onto sections, each with its own shoot and mote. Iron of the out stem Pot each rootea cuting one a small pot of caches sociolics.

or cod longer cuttings, as shown above and root at 61°F (16°C). Coil cuttings of the heart or rosary vine (C. linearis subsp. woodii), each with 1–2 tubers

Larger tubers make good rootstocks for flat grafting the milkweed family

#### OTHER CACTI AND SUCCULENTS

CHE R DOPSIS As Haworthia (see p.247) 1.

COPIAPOA Sow seeds (see p 232) at 66–75°F (19–24°C) from spring to summer slow \$1. Take stem cuttings as for Mammiltana (p 248) \$1

Corrected to Endistanceds and cuttings as for Cere is used above) [
Cyphostematal Sow seeds (see p 232) at 64–70°F (18–21°C) from spring to early summer [
Delosperstal As for Conophytum

tsee facing page) 1.

Dioscorea (syn Testialmana)

Sow seeds (see p.232) in autumn
at 66–75°F (19–24°C) 1

Cuttings are very difficult

Discocactus. Sow seeds as for

Gymnocalycium (see p.247) 11

Divide offsets as for Mammutaria p.248) | Disocactus As for Epiphyllium (see p.246) | Disosastitest, M. As for Conophytum (see facing page) | Di Di Pieya. As Acontum (p.242) | Di Di Pieya. As Acontum (p.242) | Di Di Pieya.

Propored

51.00

## **CLEISTOCACTUS**

SEEDS from spring to summer 1
CUTTINGS from late spring to summer 11
GRAFTING from spring to summer 1

Seeds are produced in green, yellow, or red berries, Sow them (see p 232) to germinate at 70°F (21°C)

The rigid stems of upright species such as the silver torch (Cleistocactus strausit) furnish columnar stem cuttings up to 6it (2m) long (see p.238). Cuttings from clumping species such as C. winters with slender, arching stems are easier to manage if only up to 2ft (60cm) long Support cuttings with stakes to prevent them from bending while they root, usually 1-4 months. It takes 2-3 years to produce a good-sized plant

Crested, or cristate, Classocactus forms may be flat grafted to preserve their characteristics (see right and p 239). Classocactus tolerate a minimum of 50°F (10°C).

#### FLAT GRAFTING A CRISTATE FORM

When flot grafting a cristate
Cleistocactus, take a fanshaped section of the crest (here of
C winter) to prepare as a scion
Cut off the sides of the crest and
then the base to create a roughly
rectangular scion about %-1 or
(2-4cm) wide if the sides an mataken off, they will grow into the
soil and rot



2 Prepare a suitable rootstock (here a front (lent) Echinopsis scopulicolus). Unite the second of the letter with rubber bands until signs of new growth appear. Grow on in a bright place at 61% (16%)

Discard vides

of crest



3 After one year or should have developed the convoluted form of its parent. Eventually the crest will grow down to the base of the sector and the corrugations will spar over and conceal the tootstock beneach

## CONOPHYTUM



Conophycum bilobum CUTTINGS spring or in late sommer to early autonomity

These succulents prefer temperatures above 50°F (10°C) Gather the minute seeds in autumn and surface-sow (see p 232) at 70°F (21°C) in

humid shade at once to allow seedlings the maximum time for growth before summer dormancy

The best time to take stem cuttings (see p 236) is in late summer or early autumn when the plants first show signs of coming out of dormancy. Separate the heads and cut each at the base. Keep moist at 66°F (19°C) to root in 2–4 weeks. If a plant has not come out of dormancy by late autumn, the stems are probably dead, treat the heads as cuttings and keep dry in cool weather. They root rapidly when warm and moist th spring and flower in 3–5 years.

## CORYPHANTHA

SEEDS in spring or in early summer !

Division from late spring to early summer !

Most of these cacti are solitary or offset slowly so are best raised from seeds (see p 232). Gather large, brown seeds from the green seedpods and sow at 66–75°F (19–24°C). A good-sized plant will develop in about five years.

A few species, such as Coryphantha elephantidens, produce multiheaded clumps with numerous offsets. Rooted offsets may be divided (see p 2.35) and replanted or potted singly or in clumps.

## COTYLEDON

SEEOS in early spring \$

OUTINGS from spring to summer \$

Most species in this genus may be raised from the dustlike seeds (see p 232), sown at 66-75°F (19-24°C)

Take stem cuttings (see p 234) from bushy forms such as the panda plant (Cotyledon tomentosa). Semi-ripe, 2-3in (5-8cm) long stems give best results.

ionger cuttings bend while they root and make untidy plants. If kept moist, the cuttings should root in 3-4 weeks and be ready for planting out in 2-3 months. Many species may be increased from leaf cuttings (see p 235). Leaves that have dropped off may not retain their axillary buds, so always take fresh leaves from the plant. Plantlets form in 1-3 months.

## **CRASSULA**

SEEO8 from spring to summer !

Division from spring to summer !

STEM CUTTINGS from spring to summer !

LEAF CUTTINGS from spring to summer !!

This diverse genus contains a wide range of succulents that grow best at a minimum of 41–50°F (5~10°C) Raising most of them from seeds is very unpredictable. Taking stem cuttings is probably the easiest means of increase, leaf cuttings are fairly easy, but slow. Some low, clumping species such as Crassilla schmidtir may be divided.

#### SEEDS

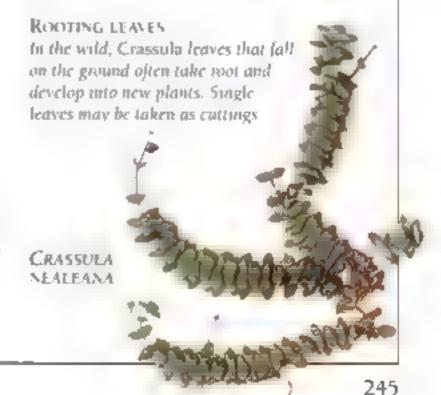
Crush the minute, dry seedpods to gather the dustlike seeds. They tend to be short-lived, germination rates vary from 1–2 to 100 percent (see p.232)

#### DIVISION

Mat-forming species that readily root from the creeping stems may be lifted and divided. Gently pull or cut the plant into suitable pieces and repot or replant them (see p 234). Within a few weeks, the divisions should fill out and make neat, new clumps

#### CUTTINGS

Take 2-4m (5-10cm), semi-ripe stem cuttings (see p.236). Large bushy plants with thick stems, such as the silver jade plant (C. arborescens) or dollar plant (C. ovata, syn. C. argentea), are rooted from 5-10m (13-25cm) cuttings. Trim off some leaves to avoid stems bending under the weight while rooting. If taking leaf cuttings (see p.237), use fresh leaves just above the point of active growth. They take a year or so to form a plant.



## **ECHEVERIA**

SEEDS from spring to summer \( \)
DIVISION from spring to summer \( \)
ROSETTE CUTTINGS from spring to late summer \( \)
STEM OR LEAF CUTTINGS (rops spring to summer \( \)

Sow seeds of species in this genus (see p.232) at 61-66°F (16–19°C). Matforming plants that root along the stems may be divided (see p.234). Take rosette cuttings (see p.237) from plants that produce offsets. Those with few or no

offsets may be increased by leaf cuttings (see p 237) taken from the main stem near the base of the rosette. Leaves of many showy hybrids and a few species will not come away cleanly from the main stem, instead, use lower leaves from flower stems, before the flowers open. Older plants may be ungainly, cut the stems 3 in (8cm) below the rosettes and treat as stem cuttings (see p.236)

## ECHINOCEREUS HEDGEHOG CACTUS



L. homeerens

stre me as

SEEDS to spring or service & CUTTINGS In m. ate spring to summer \$1.

Cacti in this genus with dense, comblike spines, such as Echinocereus reichenbachti, are fairly slow-growing and best raised from seeds (see

p 232) sown at 70°F (21°C). Those with open spination, such as E-cinerascens and E-pentalophus (syn. E-procumbens), tend to be faster growing and make fine

clumps: these each can also be increased from columnar stem cuttings

Sever a stem near its base and frim to 2-4in (5-10cm). Leave for 1-2 weeks to callus, then treat as standard cuttings (see p 238). They may take 1-3 months to root and produce a good plant in 1-2 years. It is possible to take cuttings from the slower-growing species, but they may take up to two years to root and are very prone to rot. Most species tolerate temperatures to 45°F (7°C) if dry, but prolonged cold marks plants badly

## **ECHINOPSIS**

SEEDS from spring to summer 1
GLOBULAR STEM CUTTINGS IN spring or summer 1
CQLUMNAR STEM OUTTINGS from spring or early
summer 11

This genus, hardy to 50°F (10°C) includes each formerly classified as Lobina and Trichocereus. Species may be raised from seeds. The type of cutting depends on the plant habit. Tall-growing species make good rootstocks.

#### STEDS

To set seeds, flowers must be handpollinated (see p 23.3). Fruits take 2-4 months to ripen, then split to reveal the seeds, sow (see p 232) at 70°F (21°C) Most globular species are suitable for hybridizing (see p.21). Try crossing E axygona with highly colored species such as E aurea or E arachnacantha

#### CUTTINGS

Globular echinopsis and species such as the peanut cactus (*E. chamaecereus*) produce numerous offsets that fall away at the touch of a finger. Take globular stem cuttings (see p. 238). If taking stem cuttings from columnar cacti (see p. 238) sever each stem 12–18in (30–45cm) from the base to allow for new growth. Trum cuttings to less than 4ft (1.2m) and allow to callus for 3–6 weeks.



ECHINOPSIN CALOCHEORY Although many Echinopsis are globular in shape others, such as this E calochl un are summar in habit wher coming Asolics madice that leave range spires ling clamps of exceping stems. These Echinopsis may be increased by columnar stem cuttings

## EPIPHYLLUM ORCHID CACTUS



f piphythiai

SEEDS in spring or summer 1
Cuttwick from spring to but
summer 1

For best results, sow seeds (see p 232) of species fresh at 70°F (21°C). Hybrids may be cross-pollinated (see p.133) easily, but the

seedlings vary greatly in hue and form beed-raised plants flower after 4-7 years.

By far the easiest way to increase orchid each is by flat stem cuttings (see p 238). Cut stems into 6–9in (15–23cm) lengths. Very short cuttings usually take an extra 1–2 years to flower. The cuttings should root in 3–6 weeks, those rooted early in the year often flower in the following spring. All Epiphyilum need a minimum of 50–59°F (10–15°C).

## Euphorbia

SEEOS from spring to summer 11
COVENOS from m. dspring to midsummer 12

Succulents in this genus are tender, many needing a minimum 45–59°F (7–15°C). Their milky sap is very irritant and can cause blindness if rubbed in the eye, it is hardened by water but can be washed off with warm soapy water. Dip cuttings in, and spray the parent with, water to coagulate sap at the wounds. The seeds are normally rare and costly. (See also Perennials, p. 196.)

#### SEEDS

The seedpods explode when ripe, so the paper bags over them to gather seeds (see p.232). Viable seeds germinate well at 59–68°F (15–20°C). Keep seedlings and plants at a minimum 61°F (16°C).

#### CUTTINGS

Globular species such as E globosa and E obesa sometimes form offsets. Sever these in midspring to midsummer and treat as cactus stem cuttings (see p. 238)

Some thick-stemmed, cactuslike Euphorbia, such as E. canariensis, are fairly easy from cuttings; other small, slow-growing ones are more challenging Take stems up to 6ft (2m) long from late spring to early summer, avoid unripened growth. Allow to callus for 1–2 weeks or more, then treat as cactus stem cuttings. They should root in 1–6 months.

In late spring, take up to 6m (15cm) long stem cuttings (see p 236) from bushy, slender-stemmed species such as the crown of thorns (E milit). They should root in 3-6 weeks. Do not disturb the cuttings until active growth is visible, because the new roots are very brittle. Cuttings produce attractive new plants in about a year.

## GASTERIA

SEEOS in spring or in automn 1
Division in spring to automn 1
Cuttings from spring to summer 11

This recently revised genus of rosetteshaped succusents now contains just 16 species. It is best to avoid propagating the plants while they are flowering. They need a minimum of 45°F (7°C)

Gasterias take about three years to make decent, small plants from seeds Sow (see p 232) at 66-75°F (19-24°C)

Most Gasteria offset fairly freely to form closely packed mounds. They need to be divided (see p 234) with a knife, so the parent plant must first be lifted or knocked out of its pot (see right). Allow the cuts on the offsets to calcus for two days in a warm, airly place, then pot to grow on Older offsets often have their own roots, make sure the neck of each sits in the grit top-dressing and the roots are in contact with the soil mix. Pot young offsets with no roots in equal



DIVIDING OFFSETS
Lift the plant there Gasteria
carmata var. vertacosa
and select a young heatily
offset. Shake off as mach
soil mix as possible from its
roots. It se a sharp knife to
sever the offset (see inset
at the point where it is
attached to the parent plant

parts of fine grit and cactus soil mix and keep slightly moist. Offsets taken in early spring make good plants in a year

Gasterias will root from leaf cuttings (see p 237), but they are not always successful and are rather slow. Take

fresh leaves from about halfway up the plant. Set the cuttings in small pots of almost pure gravel. Water frequently to prevent drying out. Plantlets should appear in 3-6 months at the bases of the leaves and take 1-2 years to form plants.

## **GYMNOCALYCIUM**

SEEDS from spring to autumn 1
Division from spring to autumn 1
GRAFTING from late spring to summer 111

These eacti prefer a minimum of 50°I (10°C). Most species are easy to grow from seeds. One or two species, such as Gymnocalcum andreae and G. brachin offset quite freely and may be divided. Grafting is necessary to increase the brightly colored neon eacti cultivars.

#### SEEDS

The plum-shaped fruits ripen to green blue, or red, and seeds vary from very small to large. Sow the seeds (see p.232) at 66–75°F (19–24°C). Many smaller species flower in 2–4 years.

#### DIVISION

Lift and divide them as for Gasteria (see above and p 235). They should make flowering plants in 2-3 years.

#### GRAFTING

Neon cacu lack chlorophyll and so cannot sustain themselves

Each must be flat-grafted onto a green rootstock that is taller than normal so that it can sustain itself and the secon (see below and p 239)

GRALLID SEON CACTLS
to content this plant, flor grate
a scion from the neon cactus
here Cosmon a research
milianovichú Red Capa
onto a 4-ton (10-15) m) tan
belunopsis rootstock. Korp
the plant out of full sine to
protect the tender, colored scion
from scorebing and tading

## Haworthia

SEEDS OR Spring or in automo 1

Division or spring or in automo 1

COTTINGS from Spring to sequent 11

Viability of seeds rapidly declines after six months, but fresh seeds (see p 232) germinate well, for plants in 2–3 years Many species offset freely and may be divided (see p 234) separate rooted rosettes, break clumps (H attenuata. H cymbiformis) into sections, divide stolons of species such as H tesseltata and H limifolia Sever offsets of taller species (H glauca, H. reinwandtii) at the base; treat as stem cuttings (see p 236) Some root from leaf cuttings (see p 237) it is slow (1–2 years for a plant) but useful for plants that do not offset

#### OTHER CACTI AND SUCCULENTS

HARRISIA Sow seeds and take cuitings as for Cleistocactus (p.245) ‡

pads long, from spring to autumn, take 3–5 pad cuttings from club-shaped stems [] Heliocereus As for Epiphyllion (see facing page) 1.

Hyloceres As for Epiphyllum (see facing page) 11

JATROPHA As for Euphorbia (facing page) 11
JOVIBARBA Sow seeds (see p 232) in early
spring at 50°F (10°C) 1. Take rosette
cuttings (p 232) in spring and summer 1

## HOYA WAX FLOWER



Herrie

SEEDS in spring or summer 44 Cuttings from spring to summer 44

Most of these succulent and semisucculent plants need a minimum of 50°F (10°C). Tufted seeds are carried in long pods. If sown fresh (see

p.232) and kept moist at 70–81°l (21-27°C), they can germinate in a few days. Most, however, are increased by cuttings. Cut a length of stem just below a leaf node and 3–4 nodes long. Dip the base in hormone rooting powder, which also helps to stop the milky sap from leaking. Treat as stem cuttings (see p.236) to root in 2–6 weeks. New plants flower in 1–2 years

## KALANCHOE



SEEDS in spring to autumn 11 STEM CUTTINGS from spring to LEAF CUITINGS from spring to summer 1 PLANTLETS from spring to autumn 1

messlelduara

Seeds of Kalanchoe (including Bryophyllum) may be extremely viable or very weak,

sow them (see p 232) at 70°F (21°C) The easiest way to propagate bushy plants such as K. blossfeldiana is from stem cuttings (see p 236) Allow the cuttings to callus for 24 hours. They should root in 1-2 weeks. Take cuttings atter flowering to obtain new, flowering

plants in the following spring

A number of small, leafy species, such as K. pumila, are grown from leaf cuttings (see p. 237) and root in 2-6 weeks. Some large, fleshy-leaved species, such as K. beharensis, root very readily from mature leaves (see top right) to form new plants in 1-2 years

Some species formerly classified as Bryophyllum have slightly notched leaf edges from which adventitious buds are produced. These buds fall to the ground in the wild and form new plantlets, they seem to root anywhere. K. tubiflora and K. daigremontiana are easy to propagate. in this way (see right). Grow plantlets in clumps or pot singly for new plants in 3-6 months. Kalunchoe requires a nunimum of 50°F (10°C)

#### TAKING KALANCHOF LEAF CUTTINGS



Remove healthy leaves with stalks intact there L of Kalanchoe behavensis) from the purent plant. Thread onto a length of wire and hang in a warm, airy place, out of direct sun. Make sure that the leaves do not touch each other

Parent leaf shrivels up Plantlets produced from hads at base of teaf stolk

Plantlets should from at the bese of ter leaf. studes after 3-6 corner Co., these are large enough to handle, detach them and pot them individually in 2in (5cm) pots of caetas potting nits to grow on. Label and water

#### KALANCHOES FROM ADVENTITIOUS BUDS



his me h men you and is my goods I pull away some plants x as also take as buds, from the notched leaf mar, as there is Kalanchoe tubillora, syn K. delagoensis) The plantlets root very readily, even in carpet



Three-quarters fill a 2in (5cm) por with actus soil nits. Add a sm (Icm) layer of fine grit. Set about six plantlets on top. Keep. slightly moist in a height, atry place out of direct sun. They should root within a few days

## LITHOPS LIVING STONES



ear ismencina

SEEDS IN AUTUMN OF Spring 41 CUTTINGS in early summer 11

These succulents are slow-growing and very prone to rot. Because of this, they need some care in propagation Lithops are hardy to 54°F (12°C)

Because of their slow growth, most Lithops are raised from seeds (see p 232), which germinate easily in most cases The seedpods ripen in the summer, crush them to gather the small seeds and sow at 66-75°F (19-24°C) for new plants in 2-3 years. The difficulty lies in protecting seedlings from rot

Offsets of one or more heads may be removed from larger clumps and treated as globular stem cuttings (see p.238). Many of the cuttings may rot, so be sure it is worth splitting the parent clump. Allow the heads to callus for a few days then pot in small gravel. Keep slightly moist, but not wet, roots should appear in 1-2 weeks. It takes 1-2 years to form a new plant.

## MAMMILLARIA PINCUSHION CACTUS

SEEDS from spring to autumn | **DIVISION** from spring to summer 11 CUTTINGS from spring to summer 11

Self-fertile species often set seeds, taking up to a year to form mostly red, candlelike pods. Gather seeds when the pods are soft, and sow (see p 232) at 66-75°F (19-24°C). Seeds remain viable for S-10 years. Seedlings flower in 2-5 years

Mammiliarias form clumps with age, but the offsets usually do not root while still attached to the parent. Very smallheaded clumps such as M. vetula (syn-M magneticula) may be rooted, however, and lifted and divided into sections (sec p 235) Allow any cuts to callus for a few days before repotting or replanting.

Most offsets are treated as globular stem cuttings (see p 238) for new plants in 2-5 years. The heads of some freely olfsetting species, such as M. gracilis and the strawberry cactus (M. prolifera), fall away at the slightest pressure. Other clumps should be lifted and suitable offsets severed with a knife. These cactineed a minimum of 45-50°F (7-10°C)

#### OTHER CACTI AND SUCCULENTS

K TINIA Seeds (see p 232) at 68°F (20°C) in spring or summer 1. Divide stolons or tubers (p 235) in spring or summer 1 LAMPRANTHUS As Conophytum (see p.245) 1 MALEPIKIKA As Conophytion (see p 245) 1. MATUCANA, Sow seeds as for Gymnocalycium (see p 247) 4 MELOCACTUS Seeds as for Gymnocolycum. (see p.247) 1. In colder areas, graft seedlings as Astrophytum (p 243) 1. Flat graft (p 239) small plants late spring to midsummer 👪 Monadenium Sow seeds (see p 232) at 66-75°F (19-24°C) in spring [ Stem. cuttings (p.236) in spring or summer 👪 NO OPERTURIAL Sow seeds as for Gymnocalycium (see p 247) | NOLINA Sow seeds (see p.232) at 66–75°F. (19-24°C) in spring I. Cuttings difficult Orlocereus (includes Borgicacius). Sowseeds (see p 232) at 70°F (21°C) in spring or summer 1.

OROYA Sow seeds as for Gymnocalycium (see p.247) L

PACHYCEREUS (includes Laphocereus) Seeds or cuttings as for Cereus (see p.244) 1. PACHYPHYTUM As for Echeveria (see p.246) [...

## OPUNTIA PRICKLY PEAR

SEEDS from spring to summer 11 CUTTINGS from spring to summer |

Some of these reproduce so readily in favorable conditions (some are hardy to ~10°F/ 23°C) that they have become weeds in some regions. Avoid contact with the painful barbed spines and smaller spines, calted glochids

The large, hard-coated seeds are produced in often edible fruits. They can take up to two years to germinate and then may yield a poor percentage of seedlings. Sow (see p.232) at 70°F (21°C) for a decent plant in 3-5 years

Many Opuntia have flat, oval, padike stems, which root very readily as stem cuttings. Take them as shown (see right) and keep them slightly moist at 66°F (19°C). The cuttings should root in 2-6 weeks and should form a good-sized plant in 2-3 years

#### OPUNTIA STEM CUTTINGS



West that genes and use a paper collar to guard against A the burbed spines. Use a sharp knife to sever a pad, cutting straight across a joint. I cave the cutting in a warm, dry place for 2-3 days to allow the wound to callus (see mset)



Two-thirds fill a small pot with soil nies, topped with a layer of fine grat. Stand the cutting on it. Add more gett.

## Parodia



Patrodia magnifica

SEEDS from spring or utumn . CUTTINGS from spring to GRAFTING spring to summer !

Most of these tend to be solitary until quite old, so the best method of increase is from seeds

A few, such as Parodia ottoms freely produce offsets, which may be used as cuttings. Special forms are best grafted Cacti in this genus (syn. Eriocactus Notocactus, Wigginsia) are hardy to 41-50°F (5-10°C)

#### SEEDS

Seeds are produced in spiny berries or red pods. Those in the Notocactus group. are easy to raise from seeds. Sow them (see p 232) at 19-24°C (66-75°F) to germinate in 2-3 weeks. Seedlings of the Parodia group are slow-growing for the first two years but then grow rapidly and soon eatch up with other species New plants flower in 3-5 years

#### CUTTINGS

Sever offsets at the bases and treat as globular stem cuttings (see p.238) for new plants in 2-3 years. Offsets of P ottonis form at the ends of short stolons. Lift the parent plant, and they should come away very readily

#### GRAFTING

Cuttings of misshapen forms will root, but as grafted plants they are less prone to rot Flat-graft (see p.239) monstrose stems, graft sections of crested (cristate) forms as for Cleistocactus (see p.245) for an attractive plant in 2-3 years

## PELARGONIUM GERANIUM

SEEOS in autumn or in late winter \$ DIVISION in spring to summer 11 CUTTINGS from spring to summer 11

Of succulents in this genus, the species are easy to raise from seeds. Most fleshystemmed and shrubby forms are grown from cuttings. Tuberous species or plantlets may be divided. These plants prefer a minimum of 50°F (10°C). New plants flower in 1-3 years. (See also Perennials, p 205.)

#### SEEDS

Remove the "parachutes" from the small seeds to sow (see p.232) at 66-75°F (19-24°C), germination occurs in 5-25 days. In hot weather, seeds of many succulents lie dormant so are best sown after summer Seedlings may damp off (see p 46) if chilled or in poor light

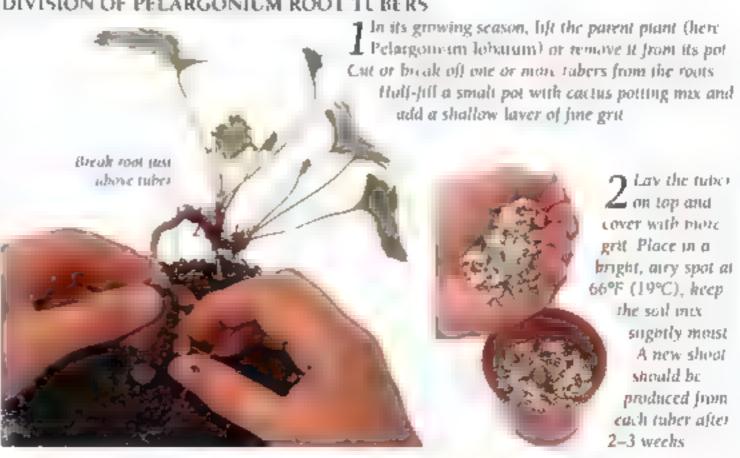
#### DIVISION

Separate root tubers of mature plants as shown below for new plants in 1-2 years. Treat as adult plants, but water sparingly until new growth is visible Some species, such as P graveolens, form plantlets on underground stems, these are easy to lift and divide (see p 235)

#### CUTTINGS

For shrubby succulents, take 2-4m (5-10cm) semi-ripe cuttings (see p 236), cut below a leaf scar. Dip in weak hormone rooting compound, dry for 24 hours. Set in soil mix, water in, then do not water for two weeks. If they do not root, keep just moist and roots should appear For those with thick, fleshy stems, allow cuttings to callus for about a week then treat as above

#### DIVISION OF PELARGONIUM ROOT TUBERS



## REBUTIA



SEEDS in spring and in autume | DIVISION from spring to early summer 1 Cuffings from spring to early sumpier L GRAFTING from late spring or

Rehuted wessneriana

Most of these (including Sulcorebutio and Weingartia) tolerate dry cold to 15-25°F (-17 to -4°C) and are easy to increase by seeds, division, or cuttings

late summer 1

#### SEEDS

Sow seeds (see p 232) at 70°F (21°C) for flower in two years or so. Avoid sowing in midsummer; temperatures over 84°F (29°C) seem to inhibit germination

#### DIVISION

Several species, such as Rebutta albiflora, make mats of small heads, which root down on their own. Simply break a clump into sections (see p 235) for new plants in 1-2 years. Allow to callus for two days, then replant or pot

#### CUTTINGS

Most species offset freely into clumps Sever offsets at their bases and treat as globular stem cuttings (see p 238)

#### GRAFTING

Flat-grafting (see p 239) onto columnar Echinopsis is best for forms that rot easily, such as R cantgueralit f. rauschif, or do not root readily, such as R. heliosa

## SCHLUMBERGERA CHRISTMAS CACTUS

SEEDS in spring \ CUTTINGS in spring and summer | GRAFTING in midsummer 11

These each must be cross-pollinated to set seeds. The grapelike fruits soften when ripe Sow seeds (see p 232) at 66-70°F (19-21°C) for plants in 3-4 years. For flowering plants in one year, take flat stem cuttings (see p.238), 2-3 whole segments long, as the plant starts into growth. They root very readily Root three cuttings back-to-back in a pot for a bigger, more balanced plant. Christmas cacti may be apical-wedge grafted (see p 238) onto an upright rootstock, such as Selentcereus, to create a standard in 2-3 years. Plants are hardy to 41°F (5°C)

## RHIPSALIS MISTLETOE CACTUS

Seeds from spring to autumn !! CUTTINGS from spring to autumn 1 GRAFTING from late spring to midsu un 111

This genus includes each formerly known as Lepismium, all grow best with a minimum of 45°F (7°C). Most may be raised from seeds. Taking cuttings is usually quick and easy. Rhipsalis may also be grafted to create a standard with a head of pendent stems.

#### SEEDS

Most Rhipsalis flower fairly easily and produce tiny, bright berries, which take about six months to ripen and become sticky. Wash the seeds in warm, very slightly soapy water, dry, and sow at once (see p 232) at 66-70°F (19-21°C) for flowering plants in 3-5 years.

#### CUTTINGS

To take a stem cutting, detach a slender stem at a joint and cut it into 4-6in (10-15cm) long sections. Treat as for flat stem cuttings (see p.238). The

#### SIDE GRAFTING RHIPSALIS



A scrott from a species such as Rhipsalis pilocarpa (see moistock (here Selenicereus).

cuttings should root in 3-6 weeks and will make mice plants in 1-2 years

#### GRAFTING

For the rootstock, use a piece of stem from a Selentcereus (see facing page), and



Place the scion and stock together so that Let the combium layers meet, If necessary, place the scion to one side of the stock. Press stightly to remove any air bubbles. Pin in place with a cactus spine (see inset) and bind the graft with raffia. Stake if necessary and grow on

stake firmly. Prepare the stock and scion as shown above (see also p.240). Once active new growth is visible, usually 2-3 weeks later, remove the raffia. Growth is usually fairly rapid thereafter, producing an attractive plant in 1-2 years

#### OTHER CACTI AND SUCCULENTS

Pereskia Sow seeds (see p 232) in spring at 66-75°F (19-24°C) Litake sign cuttings (p.2 fe. from late spring to summer 1. PILOSOCEREUS Sow seeds and take cuttings as for Cereus (see p 244) L Pleiospilos As for Hawarthia (see p 247) 1. PTEROCACTUS Sow seeds as for Gymnocalycium (see p.247) 1. Take cuttings as for Mammillaria (p.248) 1. RHODIOLA As for Sedum (see

Jacing page) 1. RUSCHIA As for Conophytum seep. +1 1 STAPELIA As for Hawarthia (see p.247) L STENOCACTUS (syn Echinofossulocactus) Sow seeds as for Gymnocalvetum (see p 247) 1 Take cuttings as for Mammillaria (p 248) L STENOCEREUS Sow seeds and take cuttings as for Cereus (see p. 244) 1. STOMATICM As for Haworthia

(see p 247) 1 STRUMBUCACTUS Sow seeds (see p.232 at 703 21°C in soring seedlings may be difficult to establish 1 SYNADENIUM As for Euphorbia (see p.246) L THELOCACTUS Sow seeds as for Gymnocalycium (see p.247) 1. TREMATOSPERMA Sow seeds (see p. 232) in spring at 70°F (21°C) 44. Cuttings are difficult TRICHODIADENA As for Canaphytum (see p 245) 1.

LEBELMANNIA Sow seeds (see p.232) at 75°F (24°C) in spring 111 Graft seedlings from late spring to midsuminer onto Pereskiopsis rootstocks as for Astrophytum (see p 242) 44 VILLADIA As for Cotytedon (see p 245 1 WEBEROCEREUS As for Epiphylium (sec p.246) 1.

## SEDUM STONECROP

Seeos from spring to autumn 
Division in spring or in late summer 
CUTTINGS from spring to summer

The succulent species in this genus (syn Hylotelephium) are easy to propagate. The method depends on the habit of the plant, Many are quite hardy, but tender species need a minimum of 41°F (5°C).

#### SEEDS

Sow seeds (see p.232) of hardier species, such as S acre, at 55–61°F (13–16°C), tender species at 59–64°F (15–18°C). Seed-raised plants flower in 1–3 years

#### DIVISION

Divide deciduous, clumping species such as S, spectabile in spring (see p.234). Lift mature mat-forming species, for example S. lydium, to find how far along the stems the mat has rooted,

then divide it with a sharp knife into sections, each with some rooted stems Divisions should flower in one year

#### CUTT NGS

Most species root very readily from cuttings, usually in 1-6 weeks. Tender plants, such as 5. rubrum, 5. hintonii, and 5. morganianum, are easily rooted from leaf cuttings (see below and p.237) for a small plant in one year. They can also be increased from stem cuttings (see p.236) to obtain plants more quickly, in 2-3 months. Cut 2-3in (5-8cm) from the tips of the stems and allow the cuttings to callus for a day. Take %-1/m (2-3cm) long cuttings of hardier, creeping forms, such as 5. spurium

Rosette cuttings (see p. 237) of hardier, rosette-forming sedums such as S. spathidifolium flower in 1–2 years

## SENECIO

SEEDS from spring to summer 1

Division from spring to late summer 1

Cuttings from spring to summer 2

Succulents in this genus, which now includes tender species of Kleinia, Notonia, and Othonna, are hardy to a minimum of 42–50°F (6–10°C). New plants reach a good size in 1–3 years.

Break the parachutes of hairs off the seeds before sowing (see p.232). Cover them with a layer of fine grit. They should germinate in 2-4 weeks.

A number of sticklike species, such as Senecio articulatus, syn. Kleinia articulata (candle plant), spread by stolons. Single stems or clumps may be separated from the plant (see below) Choose stems with adult characteristics If the shoots have no roots, add a thin grit layer to the soil mix; sit the shoot on this. Tuberous species, such as Senecio oxymifolius, may also be divided (p 235)

Take 4-6m (10-15cm) stem cuttings (see p 236) from species with thick stems and 5-10cm (2-4m) stem-tip cuttings from thinner-stemmed species

#### PROPAGATING SEDUM FROM LEAF CUTTINGS



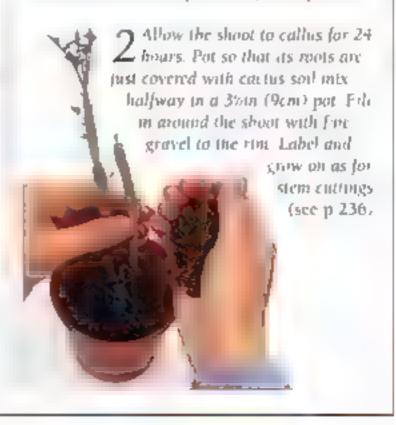
ADVENTITIOUS ROOTS Many species, such as this Sedum rubrotinetum, readily produce adventations toots from the stems and leaves. Single leaves from these plants may be rooted in travs lined with damp newspaper before potting

I AKING LEAF CUTTINGS Flick off plump leaves from the stem Place on damp newspaper in bright shade at 61°F (16°C). In 3-4 weeks the leaves should form more and prometers seemset) at their bases. Pot in pairs to grow an

#### DIVIDING A SENECIO



Life the parent plant or remove it from its pot Sciect a well developed shoot at the edge of the clump. Cut or break it off with a length of underground stem (stolon). This may already have roots. Replant the parent plant.



## SELENICEREUS



Setemicereus grandiflorus Secos from spring to autumn 1 CUTTINGS from spring to summer 1

The larger-flowered Scleniceress are known as Queen of the Night The species that have cylindrical stems, such

ns 5, grandiflorus, make good rootstocks for side grafting (see p 240) other epiphytic cacti Minimum 59°F (15°C)

Seeds are not always available since they take so long (5–10 years) to become a flowering plant, but they should be sown (see p 232) at 61–66°F (16–19°C) as soon as tipe or in spring

Most Scientcereus are fairly easy to increase from cuttings, for mature plants in 2–5 years. Take 2/-4in (6–10cm) stem sections, treat as flat stem cuttings (see p 238) to root in 3–6 weeks.

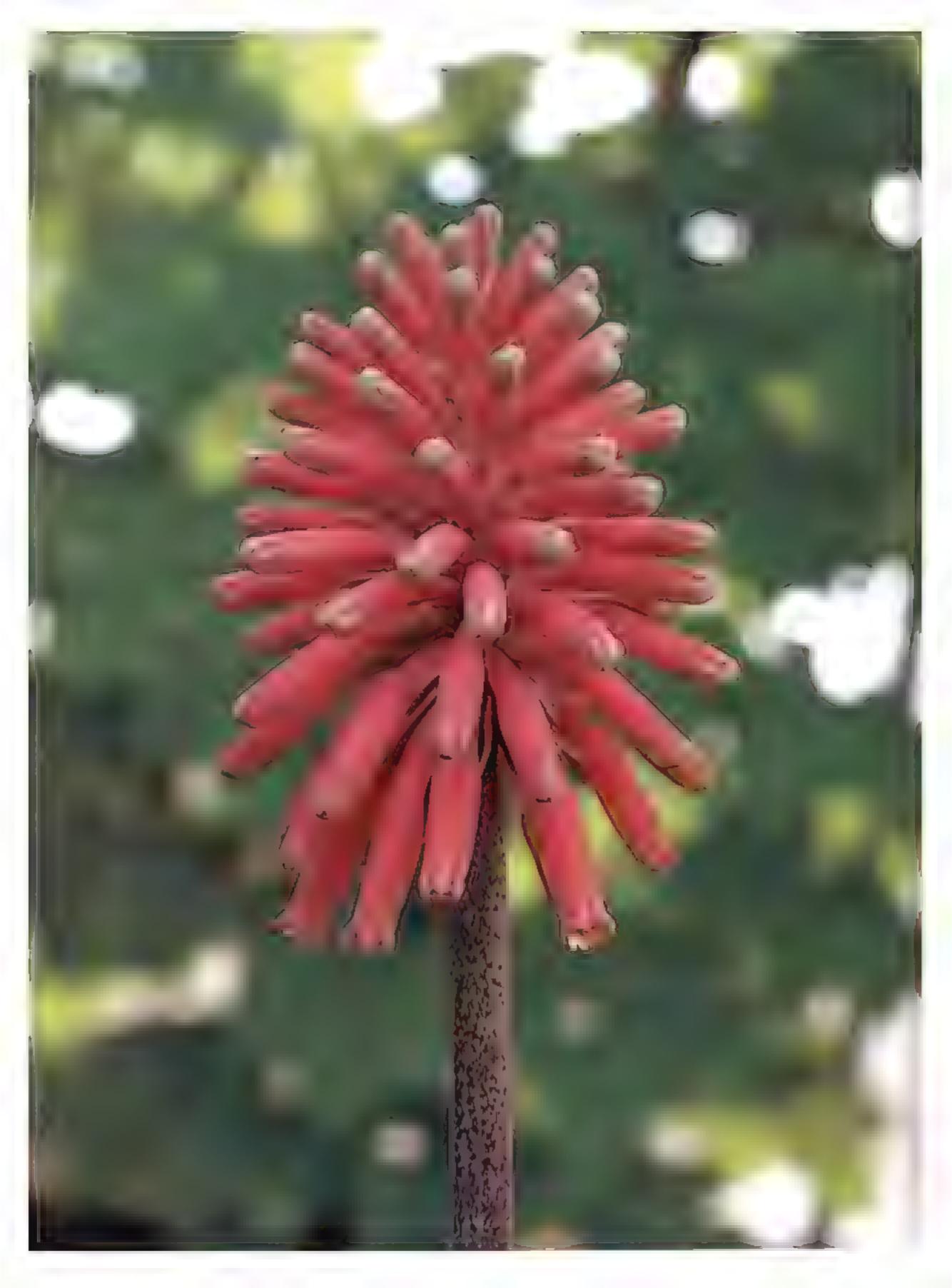
## SEMPERVIVUM HOUSELEEK

SEEDS from spring to autumn [ DMSRON in summer to autumn [ CUTTINGS in summer to autumn [

Some of these succulents are hardy to -30°F (-34°C). The rosettes die after flowering, but the plants offset freely to form a spreading carpet.

Flowers must be hand-pollunated (see p.2.3.3) to set seeds, but only a limited number of seeds may still be produced Crush the tiny, dry fruits to gather the seeds. Once they are sown, leave the seeds in a sheltered spot, such as a cold frame, to germinate

Most Sempervivum form a number of offsets each spring on long, slender stolons. These often have their own roots and may be detached and potted or replanted (see p 234). Offsets establish more quickly in 4–6 weeks if kept moist and out of direct sun. Treat unrooted offsets as rosette cuttings (see p.237)





# BULBOUS PLANTS

Most bulbous plants are best planted in bold groups or naturalized in sweeping drifts to make the most of their flowering display; propagating them enables the gardener to build up large stocks quickly and inexpensively

The propagation of bulbous plants is almost an act of faith, since so much of what happens is out of sight. Most techniques, however, are simple and can be achieved in a small space with only basic tools and soil mixes, and large stocks of plants can be built up quickly in many cases. Young bulbous plants that you have raised yourself settle well in the garden, which is not always the case with large, purchased ones.

The term bulbous plant is a broad one, used here to embrace true bulbs, corms, and tubers, fleshy structures that store food and water to tide the plants through dormant periods when they retreat underground. An understanding of the plant's annual cycle of growth and dormancy is often a good guide as to when to propagate it

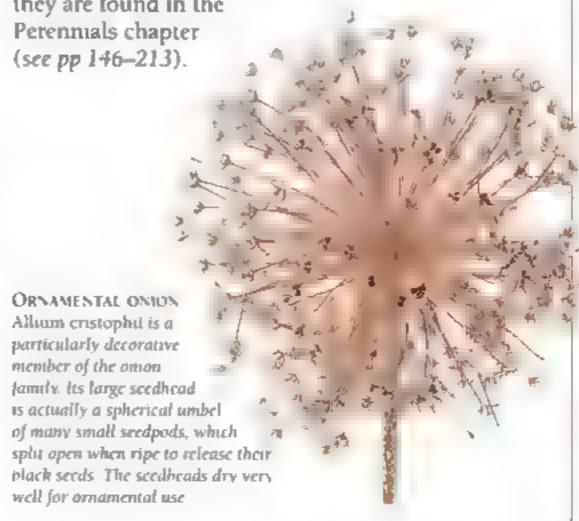
Many of these plants reproduce naturally by means of offsets, and therefore division of offset clumps is a widely used method of propagation in cultivation. Seeds are recommended for increasing species and some tubers that do not lend themselves to vegetative propagation, although patience is required because seedlings can take several years to reach flowering size

### EXOTIC BULB

There are only two species of Veltheimia, both of which are bulbs found in South Africa. This is V. bracieata It is easily propagated from seeds or offsets and imusual for bulbous plants, from leaf cuttings

There are several propagation techniques that are unique to bulbous plants, such as scaling, twinscaling and chipping, scooping and scoring, and sectioning, all of which exploit the ability of the dormant storage organ to produce new bulblets, cormels (cormlets), or tubers. Some bulbs form bulbils or bulblets naturally; these offer a way of increase that is similar but much quicker than seeds. A few bulbs can be increased from cuttings.

Rhizomatous plants are sometimes grouped together with bulbous plants, but in this book they are found in the



# **DIVISION**

Bulbs and corms increase naturally by forming clumps of small bulbs or cormels (cormlets) that draw nutrients from the parent plant. Most are attached to the storage organ itself (offsets), but some form on other parts of the plant (bulblets and bulbils) it is simple to propagate these plants by splitting them. Many tubers do not increase in this way but instead grow steadily larger; these must be raised from seeds (see p 256) or, in a few cases, from cuttings (see individual genera, pp.260–79). A few tubers (notably dahuas) form clumps that can be divided like perennials

Many garden bulbs produce so many offsets that they eventually become overcrowded, as they compete for space light, and moisture, new bulbs fail to thrive or flower, becoming "blind". Division keeps them healthy and strong

Some bulbs, such as Cardiocrinum giganteum, take several years to flower and then die, leaving a few offsets for increase. A few (Lilium candalum, Crocus tommasinianus, Nerine, and some Sternbergia) flower best if congested divide them only to increase stocks

Most bulbous plants have a dormant season and are best divided just at its onset, after the foliage has died down, but many can be divided just as they start into growth. Evergreen bulbs and corms, such as Dierama, Cyrtanthus, and Lloydia, should be divided immediately after flowering. The period of dormancy varies, depending on the species' native climate. For example, a Crinum is dormant in spring, a snowdrop in summer, and a tulip until late summer.

### **DIVIDING OFFSETS**

Most offsets usually form within the parent bulbs tunic, or skin, if there is one; they are attached to the basal plate, from which the roots grow

Some bulbs, such as daffodils and lilies, produce their offsets to the sides of the parent. In the case of tulips, the offsets are often directly beneath. Most corms, such as in gladioli, form around the basal plate, while others (Crocosmia) develop "chains" of corms.

The size of offsets varies Crinum for example, produce quite large offsets Deep digging around the parent plant is necessary to free the perennial roots before careful removal of the offsets (see below). Some Allium produce quantities of tiny offsets that are easily separated from the parent by the very act of digging up the bulbs.

Take care when litting parent bulb or corms or knocking them out from pots many are fragile and easily damaged. Clean off the soil and detach the offsets (see below). In nearly all cases, they can be removed by hand, but tightly packed clumps, such as with Anemone nemorosa, Corydairs, and Eranthis, may need to be cut free with a knife. If you wound the parent bulb, dust the exposed area lightly with a fungicide before replanting to protect it from rot

Offsets that are close in size to the parent bulb, and can thus be expected to flower the following year, can be replanted directly into their flowering positions. Prepare the site first by forking it over and clearing away any debris and perennial weeds. Work in some well-rotted organic material to condition the soil, as well as a good commercial bulb fertilizer.

### DIVIDING LARGE BULBOUS OFFSETS



In spring, below active growth begins, lift a clump of bulbs (here of Crinum) with a garden fork. Shake off any excess soil from the roots.

Pall the coor p
apart and select large
bulbs with healths
well-developed
offsets. Discard at s
that are withered
misshapen, or show
s gas of d select



2 Pull or cut the effects carefully from each bulb, taking care to preserve any roots. Dust damaged basal plates with functorde



3 Prepare 6th (15cm) pots with a moist, sandy soil new Pot cach offset individually, up to its neck. Label and water the pot

### DIVIDING SMALLER BULBOUS OFFSETS



Lift a clump of mature bulbs
Select the healthy bulbs, and
reject those that are dead or that
show signs of pests or diseases



2 Separate any pairs or clumps of bulbs with large offsets into single bulbs by gently pulling them apart, without damaging the roots



3 Clean the bulbs by rubbing them with finger and thimb to remove any local outer times. Dust the bulbs with fungicide



4 Pot the divided halbs. Plant the bulbs at twice their own depth and space them at least their own width apart.

### DIVISION OF STOCK-PLANT CORMS

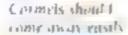


I to encourage the production of cormels (here of gladioli), shallowly plant mature corms in spring Plant in rows in a nursery bed its 2.5cm) deep and 4m (10cm) apart



2 During sammer remove the flowerheads to prevent their wasting energy on producing tonwarded seeds

in automic, or when foliage begins to die down, carefully life the corns with a hand fork. The corns should have produced targe monbers of corners around their bases.





3 Pull off the cormels. The cormels will probably vary in size, but most of them will be viable. Discard any shriveled cornels, store the rest frost-free in dry peat over winter.

Small offsets are best grown on in a more controlled environment. Some can be lined out in nursery beds, but small quantities are more easily managed if they are potted. Many should reach flowering size after two years and can be planted out in spring or autumn.

Sort container-grown offsets, once divided, according to their size, and repot in a similar soil mix

### POTTING OFFSETS

Bulbous plants need a free-draining soil mix; otherwise, they are prone to rot. Most are best in a mixture of equal parts soil-based mix and fine grit. For lime-hating species such as Lilium speciesum, make up a mixture of one part pulverized bark, five parts acidic soil mix, and five parts lime-free small gravel

Use pots that allow for two years growth, Fither plastic or clay pots are suitable, but clay pots dry out faster and so will need more watering. Most bulbs or corms should be covered to twice their own depth; some, like crocuses, pull the bulbs down to the correct level as the roots grow. Pot small offsets in groups of five or more, large ones singly



In spring, draw out drells, 4in (10cm) apart and 1in (2 5cm) deep, in a free-draining markery bed. Put coincils 1. 3in 18.8in 1980; cover water and label. Gr. w on for 2-3 years.

### AFTERCARE OF OFFSETS

Young bulbs and corms need protection from extreme heat and cold. In colder climates, most are best in pots in a cold frame (see p 40) that shelters them from winter cold and keeps out pests and weeds. Cold frames can overheat, so keep them ventilated during hot, dry spells and shade them if necessary. Iender offsets, especially corms, may need to be kept in a warm greenhouse for part of the year.

Nursery beds are suitable in warmer regions, where they may need shading or for hardy bulbs and corms in cold climates, where protection must be given during periods of severe cold Control pests such as bulb fly and mice that eat bulbs, as well as weeds

While the young plants are in active growth, feed and water them regularly it is a good idea to sink pots in a plunge bed (see p 257) or a nursery bed to keep a more even temperature around the pots and prevent them from drying out quickly, so that less watering is needed

During their dormant period, most bulbs and corms should be kept barely moist. Water them only to stop the soil mix from drying out completely. Shade

### CORMELS IN SEED TRAYS



Cormels can be planted in seed travs in moist, griffy soil mix instead of being lined out in a bed. Space the cormels 1in (2 Semi-apart, then cover with 2in (1cm) of soil mix.

summer-dormant bulbs and corms in hot weather to avoid overheating. Some, however, such as some fritillaries, must never be allowed to dry out

Shallow Planting OF STOCK Plants
Gladioli are propagated commercially
by shallowly planting stock corms to
stimulate production of cormels. This
technique (see above) can be used for
other bulbs and corms such as crocuses,
irises, or Watsonia: it takes a httle longer
than simple division but is ideal if large
numbers of offsets are needed

### BULBLETS AND BULBILS

A few bulbs, such as Iris reticulata, Ixia, some Ipheion, and Oxalis, form bulblets (tiny bulbs) around the parent, Stemrooting lilies and many Allium species form bulblets on the stem below ground Lift the parent and separate and pot the bulblets as for offsets (see facing page)

Other genera produce tiny bulbs, or bulbils, in the leaf axils (Calochortus and lilies) or flowerheads (Gagea and some Allium). They are shed naturally, often in late summer. Gather them from the ground or snap off the plant. Pot them and grow on as for cormels (see above).

# SOWING SEEDS

Ceed-sowing may seem a slow way to Dincrease bulbous plants, but it can be rewarding. It makes it easy to build up large stocks, and after two or three years, successive sowings will give a new batch of flowers each year. Rare species are usually only available as seeds. The best way to propagate woodland species, which do not tolerate drying out or root disturbance, is from fresh seeds

Bulbous plants increased vegetatively lose vigor over time and fall prey to disease, especially lilies and related genera such as Nomocharis. They can be renewed by seed-raised bulbs, which are always virus-free even if the parent is not. Cultivars may set fertile seeds but do not come true and may yield only a small number of garden-worthy plants

GATHERING AND STORING SEEDS

Seeds of most bulbous plants are large and easy to handle. The seed capsules are usually on the old flowered stems. A few bulbous plants have inconspicuous capsules at ground level (for instance,

crocuses) or produce berries (such as Artsaema and Arum) that in the wild are eaten by small mammals or birds

Ripe capsules (see below) quickly shed their seeds, watch them closely Gather the capsules (see below) and shake the seeds into a paper bag. Like capsules, berries are ripe when they turn color - squash them to extract the seeds. Wash off any pulp in warm water, then spread the seeds on paper towels to dry

Freshly sown seeds germinate quite evenly, usually by the following spring. although nearly all remain viable for a season if kept cool. Store the seeds in paper bags at 41°F (5°C) - the crisper compartment of a refrigerator is ideal In colder climates, it is often impractical to sow seeds of tender subjects when fresh because of severe winters

### SOWING SEEDS

Cut a small sample of seeds in half to gauge how many are viable fertile seeds will be fleshy and pale or translucent Seedlings form storage organs quickly,

so most seed trays are too shallow A 3/m (9cm) pot or 5m (13cm) pan is best. Mix equal parts of soil-based seed soil mix (see p.34) and fine grit or coarse sand for clay pots. For limehaving bulbs, mix equal parts peat (or coir) and fine lime-free grit (such as aquarium gravel), add a soluble feed suitable for lime-hating seedlings. With plastic pots, use six parts of grit to four of soil mix to avoid waterlogging.

Fill the pot to three-quarters of its depth with soil mix (see below). Water it by spraying the surface or by standing it in a tray of water until the surface becomes moist by capillary action, then allow it to drain. Sprinkle the seeds evenly over the soil mix. Seeds that are large enough to handle, as with some frittllaries and lilies, may be set on end,

about 5in (5mm) apart

Cover the seeds with soil mix and top-dress with fine grit to deter slugs and snails, inhibit growth of liverworts and deflect heavy rain so the soil mix surface does not pan. Label the pot

### RIPENING SEEDHEADS



### GATHERING SEEDS



Cut the ripe capsules from the parent plant there Alstroemerta) keep in a paper bug in a dry, arry place for up to two weeks. The capsules will splaopen, releasing the seeds (see anset

### SOWING SEEDS



Prepare a pot with free-draining 1 seed soil mix and firm (see inser). Tap the packet to saw the seeds evenly over the surface



1 t se a sieve to scatter a than Layer of fine soil mix over the seeds. There should be just enough men to cover the seeds.

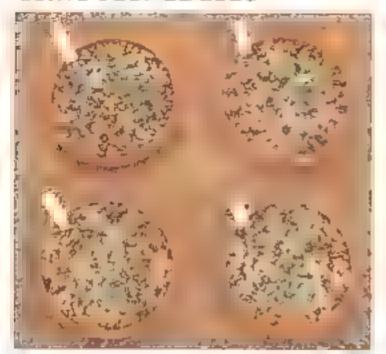


Cover the soft mox with fine grit or aquarium gravel to the pot rim. Add it carefully to avoid disturbing the seeds



A Label the pot, then stand it in T a shady area, or plunge it in a sand bed (see facing page), to keep the soil mox from drying our

### USING PLUNGE BEDS



Such pots of seeds up to the runs in a bed of coarse sand or grit in a cold frame or under greenhouse staging. Group them according to the plants, dormant periods to make watering easier

### GERMINATING SEEDS

Seeds are often spurred into germination as snow melts in the wild. A winter freeze for hardy seeds or above-freezing chill for tender seeds, even if in the refrigerator, then a period at around 50°F (10°C) aids germination. Tender seeds need a frost-free environment, some also have specific temperature and light needs for germination to take place (see A-Z of Bulbous Plants, pp 260-79). All seeds must be kept moist, if they dry our after germinating, they will die, on the other hand, they rot in prolonged moisture Their growth is also checked by extreme heat or coid, so spring sowings may be less successful than autumn sowings

A plunge bed (see above) keeps pots from drying out and moderates the soil mix temperature, so it does not overheat in summer or freeze in winter. Water the plunge medium so moisture can soak through easy pots by capillary action water plastic pots directly but sparingly. Alternatively, keep the pots in a cool, shady area, such as the fee of a wall or in a cold frame. Control any worm (see p.40), insect, or mammal activity (p.47).

Bulbous seed leaves are often grass-like in appearance. Some seeds sprout within a few weeks, but the majority of autumn sowings will not show any signs of germination until the first mild spell in late winter. Some bulbous plants, such as Paris, stay dormant for a year others, such as Arisaema and Colchictam, germinate erratically over a few years.

### CARE OF SEEDLINGS

Group seedlings according to their dormant periods. Most need to be barely moist when dormant, a few, such as lines and some crocuses, need watering all year. To bulk up seedlings rapidly, keep them in growth as long as possible by feeding and watering them regularly in the growing season. Bulb or tomato

### POTTING BULBOUS SEEDLINGS



1 One-year ald seedlings (here of Fritiflaria meleageis) are often not sufficiently well developed to pot. After the growing season allow the foliage to die back and stop was 1942

# Evenly spaced pulls.

2 In the second year, when the young bulbs are not some dormant report them to fresh gritty bulb soil more Place them at twice the own depth and spaced their own width apart

### DEVELOPMENT OF BUILBOUS SEEDLINGS



After two years, seedings
here of Calochortus tournes)
may vary noticeably in
size. The largest will have
germinated in the first year,
whereas the smallest may not
have germinated until the
second ve o

Nort the smaller from the larger seedlings and put them separately, all should develop satisfactorily

fertilizer is good, since it has a high potassium and low nitrogen content, which aids storage organ development without promoting leaf growth. When the leaves begin to wither, stop feeding.

All bulbous plants resent root disturbance, so leave the seedlings for two growing seasons before potting, unless they are overcrowded. Seeds that germinate erratically may be left longer

### GROWING ON SEEDLINGS

Pot seedlings when they are dormant and the soil mix is nearly dry. Carefully knock out the pot of seedlings, as you separate them, note the position of the growing points, because some bulbous plants, such as Erythronium and some Corydalis, look similar at both ends and it is easy to plant them upside down

In exclude worms, cover the pot base with a piece of screening. Add Am (1cm) of coarse grit for fast drainage, then three-quarters fill the pot with a soil-based poining mix combined with an equal part of fine grit. For lime-hating plants, use acidic soil mix. Top it with Am (1cm) of fine sand to keep each basal plate or base in a free-draining.

area and make it easier to see the tiny storage organs when repotting. Space the storage organs (see above) to allow for two more years' growth before planting out. Cover them with soil mix, then with a Am (1cm) layer of fine grit Water well and place in a sheltered place outdoors or under cover, depending on the temperature needs of the species.

Plant out very large seedlings in a nursery bed to grow on or in their final positions, where they should flower more quickly Prepare the soil first with grit and well-rotted organic matter

### SELF-SOWN SEEDLINGS

Many bulbous plants seed themselves outdoors, but it may be difficult to identify seedlings naturalized in grass. Most are best left in situ and divided only if congested (see p 254). Lift rare or tender seedlings while in growth; keep the root ball intact and pot (see above).

### HYBRIDIZING

Some bulbous plants may be hybridized (see p.21) successfully, particularly those with prominent stamens and stigmas, such as daffodils, trises, lihes, and tulips

# SCALING AND CHIPPING

Scaring, twin-scaling, and chipping are methods of propagation that are unique to bulbs. The storage organ itself is broken or cut into pieces, each of which yields a new bulb. It is a more exacting method than division (see p. 254), since a controlled environment, with moisture, aeration, and warmth, is essential for success, It is the best way, however, of increasing stocks of bulbs that do not readily increase by offsets or set seeds in cultivation.

on good-quality purchased bulbs as well as bulbs dug up from the garden. The young bulbs settle well in the garden, which is not always the case with more mature, purchased bulbs. Lily scaling, unlike seed raising of bulbs, affords no protection against the transfer of disease so only plants that are vigorous and free of disease should be used.

Bulbs that have loosely packed scales, such as all blies and some fribiliaries, may be scaled, with the scales being removed by hand Bulbs with a tighter structure, such as daffodils, hyacinths.

and Nerme, must be cut into pairs of scales. Small bulbs or nonscaly bulbs for example Hippeastrum, may be cut into chips. A piece of the basal plate must be retained on each section for twin-scaling and chipping to succeed but with scaling this is not necessary

The optimum time for scaling and chipping bulbs is when their food reserves are at maximum, during the dormant stage before new root growth starts. This is usually in late summer or early autumn for spring to summerflowering bulbs and in spring for those that flower in autumn or winter

### SCALING BULBS

After the topgrowth dies down, lift a few mature bulbs and clean off the soil Select only healthy, vigorous ones for scaling. Pull off and discard withered or damaged outer scales, then snap off the scales in succession as shown below Usually a few scales are removed and the parent bulb is replanted after treating with fungicide. For a large quantity of new plants, scale the entire bulb.

Ireat the scales with fungicide, then place them in a suitable medium in a plastic bag. This may be a peat and perlite mixture or ten parts vermiculite motstened with one part water. The bag is sealed, retaining as much air as possible to allow the scales to "breathe," and left in a dark place at 68°F (20°C).

For bulbs from cold climates, such as Lthum martagon and North American hites, the scales may well need, after six weeks' warmth, a further six weeks at 41°F (5°C) to simulate winter and stimulate bulblet production. The crisper section of the refrigerator is ideal.

A traditional alternative to the plastic bag is to insert the scales to half their depth in pans or trays filled with equaparts of vermiculite or peat and sharp sand. Keep the scales humid under a cover or in a closed case at 68°F (20°C) in the greenhouse. This makes it easier to check the scales for rot

Check the scales after a few months for new bulblets (see below), leave the scales attached to the bulblets if new roots have grown on the bulblets tiny

### SCALING BULBS



Life virus free bulbs in late summer or early autumn, before root growth starts. Clean the bulb and snap off the required number of outer scales as close to the basal plate as possible Replant the parent bulb immediately.



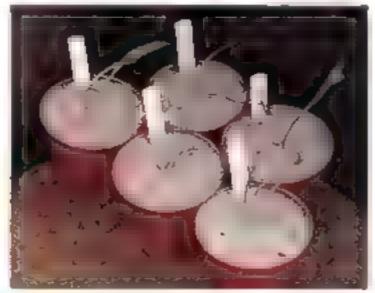
2 Put same torge dat powder in a deal proster beg. Ma the scales the core abstracts the bug gently to cout the scales thoroughts with the powder Alternatively, sook in lungicidal solution and drain.



3 Prepare a mixture of equal parts pertite and moist peat substitute or peat in a second clear plastic bag. Add the coated scales. Inflate the bag, then scal and label 11. Keep the bag in a dark place at a temperature of 68 F (20 C).



4 When hulblets have formed, usually by the spring, take the scales out of the bag. If the scales are soft, gently pull them off. If they are st li firm, or if roots are emerging from the basal processor scale callus, leave the scale attached



5 Pot the bulblets in equal parts soil-based potting mix and fine grit, singly or several to a pan. Water, label, then top-dress with grit keep them in a cool, shady place over summer then overwinter them in a cold frame



6 Pot the bulbs into larger pots each spring or autumn IJ grown several to a pan gently separate the bulbs first (see above). When the new plants reach flowering size plant them out either in the garden or in large containers.



1 Select a clean healthy, dormant bulb there Lof a diafodd) Remove the brown outer scates and cut off any old fibrous mots or dead tiss ic he pang the basal plate intact. Slice off the nose of the bulb with a clean, sharp knife

basal plate as well as on the callus at the end of the scale. Whether separated or attached, pot the buiblets individually or several to a pan, depending on their size. Insert them into a free-draining soil mix (see facing page), covering them with their own depth of mix. Use acidic soil mix for lime-hating species, or mix one part of ground bark to five of soil mix. Most new plants flower in three or four years.

### TWIN-SCALING

When twin-scaling bulbs (see above), scrupulous hygiene is essential to prevent any disease from entering the new plants through cut surfaces. Wash your hands carefully (or wear surgical gloves) and use a sterilized cutting board and tools. Wipe the knife blade with denatured alcohol between each cut (see also p.30)

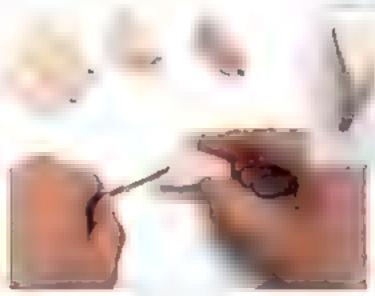
Select high-quality, dormant bulbs and clean as shown above Remove any old, outer scales. Cut the bulb into segments and split each of these into pairs of scales, starting with the outer two scales. For this task, a sharp, thin-bladed knife or scalpel is essential to keep damage to the bulb tissue to a minimum. Larger bulbs may yield up to forty twin-scales. Treat the twin-scales thereafter as for scales (see facing page), but check them regularly and remove any twin-scales that show signs of rot. In about 12 weeks, bulblets should form on the top of the basal plate Treat them as scales.

### CHIPPING

In chipping, the bulb is cut downward to produce 8-16 "chips" rather like the segments of an orange (see right) Hygiene is as important for chipping as for twin-scaling. The treated chips may be placed in a bag or a tray, as for scales, to form bulblets. Pot the chips and grow on at the recommended temperature for the species (see A-Z of Bulbous Plants, pp.260-79) to flower in 2-3 years.



Turn the bulb upside down and cut it L vertically in half and then into quarters Depending on the size of the bulb you can divide it into eight or more segments, provided that each retains a piece of the basal plate



Peel back pairs of scales from each piece. I cut them free at the base with a scuipel back pair of scales should have a piece of the basal plate attached (see inset). Dap the fivinscales in forgreidal solution and allow to drain





T Dig up a healthy bulb (here a Hippeastrum) A whor do most so I count if Remove any papers outer ship and from back the noits with a grant steady for he without curring into the basal place. Cut back the growing up.

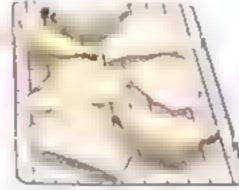


• Halding the both with the basal plate supportmost cut it into 8-16 stimitarity sized. sections ("chips"), depending on the size of the bulb. Make sure that each chip retains a free tree basal plate

Immerse chips in fungicide

Rabas HE TO THE R

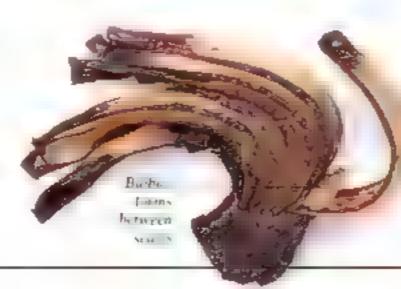




2 Soak the chtps in a fungicidal solution, I made up according to the manufacturers instructions, for up to 15 minutes to kill any bacteria or fungal spores. Allow the chips to drain on a rack for about 12 hours



4 Place the chips in a clear plastic bag containing ien parts of vermiculite to one part of water. Inflate the bug, then seal and label it. Keep the bag in a dark place at 68 F. (20 C) Check the bag periodically and remove any chips that show signs of rot



After about 12 weeks, bulblets should Jorm just above the basal plate. Pot the chips individually in 3in (8cm) pots in freedraining, soil-based potting mix Insert each chip with its basal plate downward and the bulblets covered by about sin (1cm) of soil mor Leave the scales exposed, they will slowly not away as the butblets develop-Grow on in a sheltered position, in conditions appropriate to the individual species

# A-Z of bulbous plants

# ALLIUM ORNAMENTAL ONION



Venor hochadram

Division in late summer [ BULBILS in late summer [ SEEDS in late summer to autumn or spring [ CHIPPING in early summer []]

Most of these perennials are bulbous plants, but a few are rhizomatous (see Perennials, p. 149)

They flower in spring, summer, or autumn. Propagate species such as A. flavam and A. mairei by division of offsets, and all others except sterile hybrids from seeds. Many self-seed readily in sunny, free-draining sites A few have bulbils in the flowerheads.

ACTION BUTBILS

Now of serior of species and serior of s

only spaced but

(2.5cm) apart and

covered to a depute

of Stir (Rem)

(see below) or may be chipped. All types of propagation should yield a flowering plant in two to five years.

### DIVISION

Many species, such as Allium moly, produce offsets very prolifically – some are tiny and form on the rooting portion of the stem so may easily be lost in carcless lifting or repotting of the parent bulb. After the leaves die down detach the offsets (see pp 254–5) to pot or replant, according to their size

Take care to note the position of the growing points, which are not always conspicuous, before detaching them

GATHERING ALLIUM SEEDS

### SLEDS

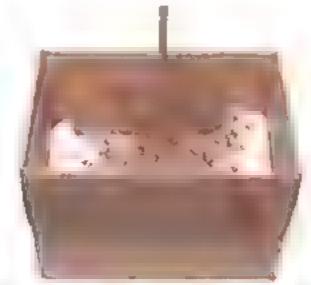
Gather seeds of large-flowered Allium by removing the entire flower stalk (see below). For smaller seedheads, shake the seeds directly into a paper bag. Sow the seeds fresh or store at 41°F (5°C) and sow in the spring (see p 256). Most germinate in 12 weeks, but some take up to a year. Take care when potting on seedlings to keep the growing points upright, they are not very obvious.

### CHIPPING

Chip (see p 259) distinctly colored cultivars such as A. hollandicum Purple Sensation' to retain the true color



Lather seeds when the flowerhead turns brown before the seedpods open 'lug gently at the flower stalk if it comes away read by at the base. It is tipe. Cover the wound with some soil to stop pests from entering the plant.



2 the codboard box with paper Hang the flower stalls upside down in a cool, airs place so that the flowerbead is suspended just above the lining of the box. The repening seed capsules will open to shed seeds onto the paper

# ALSTROEMERIA PERUVIAN LILY

Division in La State of the Army 12 Seeds and La State of 1

These perennials produce white starchy tubers, which sometimes appear like creeping thizomes. Species are best increased by seeds because the tubers are so delicate and are easily damaged, named cultivars can be increased only by division. Peruvian likes are good subjects for experimenting with hybridization (see p.21) because many of the seedlings show pleasing variations. Flowering plants may be expected in 2–3 years.

### DIVISION

Offset tubers are often connected very tenuously to the parent crown. When dividing a plant, lift the crown with great care, before the leaves have quite died down (see p 254). It is best not to spat the crown into very small pieces if replanting immediately in open ground.

### SEEDS

Alstromeria seeds should be sown freshit is hard to break the dormancy of seeds once they have been dried and stored. The seed capsules "explode" to scatter their seeds when ripe. For the best harvest of fresh seeds, cover the ripening seedhead for a few days with a small pillowcase or a cloth bag secured around the stalk, the seeds will be caught in the bag. Alternatively, cut the entire flower stalk and hang it up to dry and release its seeds (see right).

For the best rate of germination, sow the seeds immediately (see p 256). Keep them at a minimum temperature of 68°F (20°C) for four weeks, then remove the seeds and, using a knife, chip each outer case above the embryo, which shows as a dark spot. Resow the seeds and keep them at about 50°F (10°C)

The new tubers are easily damaged, so plant out the seedings by the potful, as for Frythronium (see p 267)



GATHERING ALSTROEMI RIA SELDS

As soon as the seedhead has dried fully, cut the stem at its base and tie a paper bag around the seedhead. Hang it upside down in an arry place for two weeks to gather the seeds

# **AMARYLLIS**



Amaryths beliadonna 'Hathor' Division in spring !
Seeds in autumn !

The only species,
Amaryllis beltadonna
is a bulbous perennial
hardy to 23°F (-5°C)
but needs long, hot
summers to flower well

beliadonna Hailior' II hybridizes easily with other members of the Amaryllidaceae family, such as Crinum, Bransvigia, and Nerine (see p 274). Seeds from named cultivars do not come true, so the bulbs must be divided, some may be chipped New plants flower after three years.

### DIVISION

The parent bulbs may be 8in (20cm) deep in the ground, so care is needed when lifting them. Separate the large offsets (see p.254) and grow on in pots, keeping them just moist until they are established in autumn.

### SPEDS

The fleshy seeds often germinate while still on the stem and must be gathered promptly, before they wither and die, and sown immediately. Sow them singly in 3in (8cm) pots, just covering them with soil mix or coarse sand (see p.256), and keep at 61°F (16°C). To hybridize Amarytiks with other genera, see p.21

### CRIPPING

Slow, large-flowered cultivars can be increased by chipping (see p.259) if there are not many offsets

# ANEMONE WINDFLOWER

DIVISION in mid- to rate summer 1
Secos in summer 1

There is a wide range of tuberous species in this genus. Offsets are produced 2–3 years after a plant begins flowering. The species self-sow very readily, and seedlings from cultivars of Anemone blanda, which are grown for their variation of color, are often quite acceptable. (See also Perennials, p. 188.)

Divide the offsets after the leaves die down (see p 254). Plant them where they are to flower, about hin (2.5cm) deep, to flower the next year, or pot and plant out when in full growth in the spring

The seedheads are often woolly or harry and are best sown fresh. Remove as many of the hairs as possible prior to sowing by rubbing the seeds in your hands with a little dry sand. Sow in trays in seed soil mix (see p.256) and leave in a cool, sheltered place. Germination can be erratic, the first seedlings should appear in the following spring. Most should flower beginning in the third year.

# ARISAEMA JACK-IN-THE-PULPIT



Artsuema mindidissimum

Division in autumn ‡
SEEDS in autumn ‡
SECTIONING in spring ‡‡

These tuberous perennials produce hooded, sometimes bizarre-looking inflorescences composed of a spadix

("jack") within a spathe (the "pulpit)
Tiny, scalelike offsets produced
around the disk-shaped parent tuber
can be removed (see p 254) and potted
to flower in 2-4 years. The smallest
offsets are best left attached to the
parent until the following year

Since there are no garden cultivars, all Aristema can be raised from seeds

Remove the berries from the plant as soon as they have turned red and are ripe, and squash them to release the seeds. The flesh of the berries may inhibit germination, wash the seeds thoroughly and spread them to dry on paper towels for 24 hours in a warm, arry place. Sow the seeds immediately in trays (see p 256). In any case, germination is often slow and erratic and it is worth keeping all sown seeds for up to four years before finally discarding them. Arisaema sikokianum however, germinates readily from fresh seeds. Seedlings may be slow to reach flowering size, usually in 3-5 years

Some gardeners also section the tubers when they are dormant, as for Caladium (see p.262)

# ARUM LORDS AND LADIES

Division in early summer [ Secos in fate summer to automi-

These mainly spring-flowering tuberous perennials form tight clumps and may be lifted and separated when dormant (see p 254) after flowering. This can be done even though the parent tuber has sent up 5–6 betrying stalks, it could have 50 dormant offsets around it Arum creticum in particular responds well to division

The seeds germinate best if sown fresh (see p 256). Extract the seeds from the berries, as for Arisaema (see above), but wear gloves to protect against the caustic juice. Plants flower in 3-4 years.



ARUNI BERROES

The betries there of Arum nalicum) appear in science before the autumn leaves. Gather them for their seeds when they turn is a or orange.

# BABIANA

Division in autumn 1
SEEDS in autumn 1

This member of the Iridaceae family is among the hardiest of the Cape bulbs, the corms may be left outdoors at temperatures down to 23°F (-5°C)

Lift and divide established corms (see p 255) and pot in equal parts of soil-based mix and sharp sand, or plant outdoors at a depth of 8in (20cm). Keep them well watered over winter. Flowers may be produced in the following year. Bibliana ambigua forms aerial corms in the leaf axils. In the wild, these drop to

the ground as the foliage dies. Remove them when the foliage discolors and treat as cormels (see p 255)

Gather the seeds, which ripen to black, and sow them immediately in travs of seed soil mix combined with an equal part of sharp sand. They should germinate within four weeks at 55–59°F (13–15°C). Transplant the seedings individually into deep pots of equally free-draining soil mix. The contractile roots will pull the developing corms down to the appropriate depth. Seed-raised plants flower in the second year.

### OTHER BULBOUS PLANTS

At BucA Divide offsets (see p. 254) when dormant ( 50w seeds (see p. 256) at 55–64°F (13–18°C) (syn. | 67msdonna parken) Divide

offsets as for Amaryllis (see above) 1.
Anorthophatet 5 Divide offsets if produced, when dormant (see p.254) 11.
Sow tipe seeds (see p.256)

at 66–75°F (19–24°C) [].
ANI MONELLA THAJICTROIDES
Divide Well-established
plants (see p.254) in autumn
[]. Sow fresh seeds (see
p.256) in summer [].

# BEGONIA

BULBICS in late summer or spring \$ SECOS in late summer or spring \$\$ SECTIONING in spring \$ CUTTINGS in spring \$

The tuberous perennials in this genus include the Tuberhybrida, Multiflora, and Pendula begonias, of which there are many named cultivars. All are tender and dormant in winter Some species, such as Begonia sutherlandit, produce bulbils, these provide an easy means of propagation, Seedlings are prone to damping off (see p 46), so controlled conditions are needed for success: sectioning and cuttings are less tricky Most new begonias flower in the first summer after propagation. (See also Perennials, p 190)

### BULBILS

If bulbils develop in the leaf axils, gently detach them when they are fully developed. Surface-sow them immediately as for seeds (see p 256) on moist soilless mix, or store them dry in perlite or vermiculity at 41°F (5°C) for potting in the following spring



B) GONIA SELD CAPSULE

one begonia plant can
procace once y thousands

of fine, distribe seeds

Mix the seeds with fine
sand to sow them evenly

### SECTIONING TUBEROUS BEGONIAS



I After the leaves die back or autumn. Lift the dormant tubers and clean them. Dust the crowns with no gaide and store in boxes of dry said.



2 in spring, space the tubers
'a (5cm) apart and Im
.' 5cm) deep in a tray of
moist sandy soil nits. Reep
or mat 55-61°F (13-16°C)



L se sharp

stern zed kn fr

3 When shoots appear, cut cach tuber into pieces, each with at least one shoot ond some mots. Dust the cats with fungicide, allow to calhas



4 Met a few hours, pot cach section singly or a mixture of capital parts peor and perfits a time ent so the term to cook tuber is level with the surface



5 Figure by the mand label cach pot Keep the tiders at a minimum of 64% (18%) at a binord bright place tout established see left

### SEEDS

Sow fresh seeds (see p.256) only when the day light hours are lengthening, if not, store at 41°F (5°C) and wait to sow in spring Surface-sow seeds in pans of peat-based soil mix (or a peat-free alternative). Water, then cover the pan with a sheet or glass or clear plastic and keep it at 64–68°F (18–20°C). The seeds should germinate quickly, at which time the sheet of glass should be removed.

Three to four weeks after sowing, pot the seedlings singly in a mix of equal parts peat and sand, with a little slow-release fertilizer. Feed with a tomato fertilizer diluted to half-strength. Begonias make good subjects for hybridizing (see p.21)

### SECTIONING

Large tubers with several growing points can be sectioned (see above) before planting in spring. Each section should

# CALADIUM ANGEL WINGS

Division in spring # Sectioning in spring ##

Generally, only named cultivars of these tender tuberous perennials are grown, these must be propagated vegetatively to retain the colorful foliage variations Most, including Caladium bicolor cultivars, produce offsets. The first leaves on each new plant often revert to the species and will look atypical, but in a few months the foliage will show its true colors. These are rainforest plants so the tubers will not survive drying out

### DIVISION

Lift the tubers before growth begins and snap or cut off any offsets (see far right and p 254). Grow on as for sections

### SECTIONING

Lift the often spherical tubers before growth begins and cut them into sections (see right). Cut as cleanly as possible to minimize damage to the tuber tissue. Root the sections in free-draining soil mix, such as equal parts peat and sharp sand or perlite.

### CUTTING UP CALADIUM TUBIRS



Lise a clean, sharp scalpel to cut each tuber on sections, each retaining a dormant consolid to the Press gently and smoothly on the scalpel to obtain a clean cut



3 Prepare some pots with a free draining, so ness mix. Pot each so that sangly growth out uppermost, and cover with its own depth of soil mix. Lightly water and label



2 Dust the cut surfaces of each section with a fungicide such as sulfur dust or immerse them in a suitable jungicidal solution. Leave for several days on a wire tray to dry and carries.



A Place the potted sections in a humid place at a minimum of 68°F (20°C), such as in a heated closed case. The tubers should produce shoots in 7–10 days.

BASAL STEM CLITTINGS

Overwanter a tuber as shown in steps 1 Sec. left). When the shoots are 201 (5cm) tall car. them out of the tuber, so that each has a piece. of tider at the base (see inset). Pot them singly

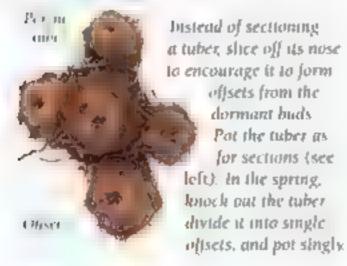
have at least one growing point and some good roots. It is best not to be too greedy: only existing roots will develop rootless sections of tuber are not able to produce new ones. When strong new shoots appear, pot them into the same soil mix as for seedlings and gradually harden off (see p. 45) in a sheltered place

### CUTTINGS

Before replanting, or as new growth emerges in early spring, cut individual shoots from the tuber, each with a piece of tuber at the base (see above). Pot these basal stem cuttings singly in equal parts peat and perlite and keep moist and humid at a temperature of 64°F (18°C) After a month, check for rooting, then treat as seedlings

During summer, cut off 4in (10cm) nonflowering sideshoots to use as stemcuttings. Root as for basal stem cuttings

### CALADIUM OFFSETS





When the shoots have ne or two true leaves, usually a few weeks later, pot each plant into 3/m (9cm) pots to grow on Place each taber at the same depth as before Water in and label

# CALOCHORTUS FAIRY LANTERN, MARIPOSA



Calocharias ventishis

DMSION in adduma ! BULBILS in automn ! SEEDS in autumin 1

Most of these bulbous perennials will not tolerate dampness or cold when dormant All may be propagated from seeds, since there

are no garden hybrids. Some species, for instance Calochortus barbatus (syn-Cyclobothra lutca) and C uniflorus, often produce bulbils in the leaf axils Division may be necessary when offsets become so congested that flowering is inhibited It can take four years to produce flowering-size bulbs

### DIVISION

The parent bulb produces offsets after flowering, usually preventing the parent

from flowering the next year Remove the offsets (see p 254) and pot in a very free-draining mix that is not too rich to avoid overly lush, soft growth. Equal parts of soil-based potting mix and coarse grit would be suitable, or even a bed of coarse sand or ground pumice Keep dormant offsets dry, and delay watering until late autumn

### BULBILS

For bulbil-producing species, collect the dying, brown foliage and tease out the bulbils. Treat as fily bulbils (see p.273)

### SEEDS

Sow seeds in pots (see p 256) as soon as they ripen. Keep them dry, but exposed to cold over winter. The seeds should germinate easily in spring, often before the parent bulbs show signs of growth

# CAMASSIA QUAMASH

DIVISION IN SURIDING ! SEEDS in autumn 1

Some species from this small genus of bulbous perennials, for example Camassia leichthait, have a number of cultivars, which can be increased only by division. Lift the bulbs after flowering and detach the offsets (see p 254). They should flower after two years

All species come easily from seeds, which are produced freely; indeed, the species will self-sow if the seeds are not gathered. Self-sown seedlings are to be found near the base of the parent plant but do not need to be transplanted They take little room and grow well, particularly among shrubs. If sowing (see p 256) the seeds, do not allow the container to dry out. Seed-raised plants can reach flowering size in three years

# CHIONODOXA GLORY OF THE SNOW



Chrondera forbesu

División in autumn ! SEEDS in autumn 1

These bulbous perennials offset very readily to produce a very good display in a relatively short time Divide clumps when they become crowded,

every 3-4 years, after the leaves have died down (see p.254) Offsets will flower after two years

Chronodoxa also set seed profusely each year If left to self-sow, a colony soon takes hold. Alternatively, gather the seeds and sow in trays (see p.256). for flowers in the third year

# CHLIDANTHUS

Division in autumn 1 Seeds in spring 1

Chlidanthus fragrans is the only species it is a tender, bulbous perennial. Offsets can be divided while dormant (see p. 254) to flower in two years. Apply a tomato fertilizer when the new plants are in active growth

Gather ripe seeds in autumn and store for spring sowing (see p 256), in cold climates, winter light is too poor for seedlings. Sow at 55-64°F (13-18°C) in trays. Keep seedlings barely moist in the winter, then treat as offsets. Lift selfsown seedlings in autumn, pot, and grow them on in a frost-free situation

### OTHER BULBOUS PLANTS

BELLEVALIA As for Muscari (see p.274) 1 BONGARDIA CHRYSOGONUM. Sew seegs when ripe in summer (see p.256). Tiny tubers form deep in put 11

Brimet RA Divide bulbs (see p.254) Land sow rape seeds in summer (see p 256) 1. Broplat a Divide corms in late summer or autumn (see p.254) L. Sow seeds at 55-61°F (13-16°C) in summer (see p 256) \$ BURBOCODIAN As for Colchicum (p.264) 1 CARDIOCRINEM. Sow seeds in deep trays. when ripe in autumn (see p 256). Shoots appear some time after germination. seedlings can take seven or more years to flower II. After flowering, bulb dies but offsets may be divided (see p 254) [1] CHASMANTHE Sow seeds when ripe at 55-61°F (13-16°C) in summer (see p 256) 1. Divide corms in spring (see p.255) 1 CRIONOSCIELA ALLEMI. Divide bulbs in summer (see p 254) 1

# COLCHICUM AUTUMN CROCUS, MEADOW SAFFRON

DIVISION in late summer or automn | SEEDS in actumn |

These cormous perennials are famous for their showy flowers that appear without leaves. Large flowered hybrids very rarely produce a better-flowered form when raised from seeds, so they are best divided. Division every 3–4 years also maintains flowering. Alpine species are best grown from seeds.

### DIVISION

Clumps of colenicums may be divided as for bulb offsets while dormant in summer (see p 254) but will stand

division while in flower, when they are easier to locate (see below). Remove the papery tunies, which can inhibit growth. A few species, such as Colchicum psaridaris, have underground stems (stolons) and should be lifted with care

### SEEDS

Gathered seeds germinate readily if sown fresh (see p 256) in pots of soil based mix. Keep them in a cool, shady position with some exposure to cold Stored seeds are not so successful and may not produce seedlings until up to four years after sowing

### DIVIDING COLCHICUMS IN FLOWER



I dt a matare champ carefully, de conto a spade blade's depth to preserve the mots. Shake of excess soil from the pulps and pull them apart. Clean off any dead matter and the strong pater tames.



2 soil with a latte bonemeal compost of soils with a compost of soils will totted leaf mold Replant the bulbs in scattered small groups at the same depth as before Space the bulbs about 15 mill apart 15 mill them in gently and water atotals not out the bulbs.

# COLOCASIA TARO

Division in spring 1
Sectioning in spring 11
Cottings in spring 1

Offsets of these tender, evergreen tuberous perennials may be divided (see p 254) and grown in rich soil or in pots at a minimum temperature of 70°F (21°C) and high humidity. Large tubers may be sliced into sections, each with a growing bud, treat as for Caladium (see p 262). Take basal stem cuttings from tubers starting into growth, as for begonias (see p 262), but grow on in humid heat. (See also Vegetables, p 299)

### OTHER BULBOUS PLANTS

Commetina Divide tubers in spring 4. Now seeds in spring at 55–64°F (13–18°C) (5ec p 256. §

# CORYDALIS

Seeds in summer #

The most commonly grown of the tuberous perennials in this genus (syn. Pseudofumaria) are Corydalis cava (syn. C. bulbosa) and C. solida (syn. C. bulbosa) and

Apecies with large tubers, such as the Leonticoidus group, rarely offset and are best raised from seeds (see p.256). Vigilance is needed to gather tipe seeds before they are shed (see below). Sow immediately or store for spring sowing, to flower in two years. Germination may be erratic. Take care to pot seedling bulbs with growing points uppermost.

### SEEDPODS

Ripe pods often stav
green and shed seeds
quickly. Hang stems of
closed pods in a paper
beet gether the beack
seeds as he peds spat spen

# **CROCOSMIA**



( 1 2 AP 4

Consider in spring or late spring of late spring 1
Section 1
Section 1
Section 1

There are numerous cultivars of these corms (syn Antholyza Cartonus). They form large clumps, which

are more vigorous and free flowering if divided every 3-4 years. Seed-raised plants are worthwhile only from species New cultivars are constantly being introduced, sectioning provides a way of bulking up stocks from a few corms New plants flower in the following year

### DIVISION

Crocosmia readily form congested mats of corms in "chains," with younger corms developing on top of older corms. Contractile roots pull the chains deeper into the soil. Normally the clumps are divided into chains after flowering (see below) or in spring, but if offsets are few

### DIVIDING A MATURE CLUMP



1 When the Johnge dies down after flowering, tift a mature clump there of Crocosmy i masoniorum). Dig at least 12m (30cm) down to avoid damaging the corms or mots.



3 lease the chains of corms apart. Clean off any dead or diseased matter and old stems. Corms may be 4-2in (1-5cm) in diameter. Pot smaller corms in soilless potting mix at the same depth as before, to but ap for a year.

or rare, the chains may be split into individual corms. Stock plants may be planted shallowly to obtain quantities of corms for division (see p. 255)

Some Crocosmia, such as C. 'Lucifer' or 'Jackanapes', produce underground stems (stolons) from buds on the corms new plants then form on the ends of the stolons. When dividing these from the parent plant, retain any portion of stolon with good fibrous roots with each offset

### SEEDS

Sow the large seeds as soon as they are ripe in soil-based potting mix (see p.256). Cultivars sometimes self-sow; grow the seedlings apart to preserve the true cultivar strain. Crocosmias make good subjects for hybridizing (see p.21).

### SECTIONING

Before new growth appears, corms of cultivars may be cut into sections, as for begonias (see p.262). Pot them or line them out in a hursery bed to grow on

### OF CROCOSMIA



2 carefully putt the tightly matted clump apart to loosen the chains of corms. It the chains of apart with back to-back forks



Prepare a planting site with plenty of well rotted organic matter. Replant the large chains of corms at the same depth as before but at least 3m (8cm) deep and about 3m (8cm) apart. Water them in thoroughly and label

# **CROCUS**

DIVISION AS LAW SUMMER !

Both spring- and autumn-flowering forms of these cormous perennials can be divided in late summer Species may also be raised from seeds. Crocus tommasinianus self-sows readily and flowers best in congested clumps, divide it only when necessary. Alpine species, such as C. gargaricus, must be kept watered while dormant. New plants take 2–3 years to flower.

### DIVISION

Crocuses generally form small corms around the parent, in bad conditions the corm produces many tiny cormels and no flowers. Some (C. nudiflorus, C. scharojanit) form cormels on the ends of underground stems, or stolons, take care the cormels do not fall out of the pot. Lift and divide corms (see p.255) and grow on in pots or plant directly in the garden. Plant stock bulbs shallowly to promote cormel formation (see p.255).



CROCUS SEED CAPSULES

As the seeds ripen, each seed capsule gradually emerges from below soil level at the base of the flowering stem. Remove it before it splits open then dry in a paper bag to gother the seeds

### SEEDS

A good rate of germination is possible with fresh seeds. Sow the large seeds in trays (see p 256). Keep the seedlings well watered throughout the year, plant out after two years. Self-sown seedlings can be left to grow on in situ

# CYCLAMEN



Cyclamen Llectum

SEEDS from madsummer 1
late winter 
SECTIONING in late summer 
\$\frac{1}{4}\$

Some of these tuberous perennials, such as Cyclamen coum, are rather hardy, while others are tender, such as C persteam

Seeds are the only reliable method of producing new plants and a lot cheaper than buying quantities of tubers. Seed-raised F1 C persicum hybrids can flower in as little as eight months. Sectioning is generally less successful but may be the only method available to the gardener of increasing stock of rare or named evelumens. Vigorous garden plants are best left undisturbed

### SEEDS

Cyclamen seeds are slow to ripen
Those of summer- and autumnflowering species, such as C. hederifolium
(syn. C. neopolitanum), ripen the
following summer in most cases, the
stems that bear the seed capsules coil
down, pulling the capsules to ground
level. (C. persicum does not coil.)
A sticky coating, which may be pale
brown, darkening with age, attracts ants,
which then quickly distribute the seeds

Cyclamen seeds are best sown fresh (see right). Sow immediately after soaking: light at this stage sends seeds into a second dormancy that is difficult to break. Sow the large seeds in a mix of equal parts seed soil mix and sharp gnt

(see p 256). Water, allow to drain, then seal the pots in clear plastic bags. Keep at a minimum temperature of 61°F, 16°C), in a lightly shaded place

Remove the bags once germination occurs. Transplant the seedlings as soon as they are large enough to handle Alternatively, if the seedlings are not crowded, leave them for a year and pot the tubers singly when dormant (this option is not for *C persicum* hybrids)

### SECTIONING

The tubers of a few species, notably C. trochopteranthum (syn. C alpinum), have numerous growing points on the top of the tubers. Lift the tubers when dormant and cut them into sections, as for Caladium (see p.262)



CYCLAMEN SEEDS

Gainer seed capsules as they began to split (see inser). Shake our the seeds. Sook for 12 hours in warm water with a little dishwashing liquid to soften the seed coats and assolve the macus.

# **DAHLIA**



Dalusi Conway

Division in spring [ SEEDS in early spring [ Cutfings in late was error spring [

There are thousands of garden hybrids of these tuberous perennials; few species are grown Dahlias are very frost-

sensitive, in cold climates, they are lifted after the first frost, stored at a minimum of 37°F (3°C), then planted or propagated in spring. Make sure that the stored tubers are cleaned of all soil and are just barely moist, otherwise, fungal infections may set in

Crumps of tubers are easily divided but, for a greater quantity of plants may be increased by cuttings. Some bedding dahlias may be raised from seeds. New plants normally flower in the same year

### DISION

Dig up a clump of tubers before spring growth commences, or bring them out of storage. Divide them into sections using a clean, sharp knife, and make sure that each division has at least one strong, healthy dormant bud ("eye") and one tuber. Dust all the cut surfaces with tangicide. Plant the divisions 4–6in (10–15cm) deep in their flowering positions immediately to grow on



I be late wither, start some dahaa tubers toto early growth, insert them into a box of soil mix, leaving the tops of the tubers exposed Keep them moist in a lightly shaded proteon according to a man man temperature of 54°F (12°C).

### SEEDS

Sow seeds (see p 256) and keep at a minimum 61°F (16°C) at all times for rapid germination. Transplant the seedlings singly into pots and plant outdoors when nighttime temperatures are 54°F (12°C) or above

Dahhas are easy to hybridize (see p.21), but the seedlings will vary wildly many will be discarded in the attempt to produce a worthwhile form

### CUTTINGS

Basal stem cuttings (see above) can be taken under cover in late winter from tubers forced into growth. Take new shoots with a piece of tuber at the base of the stem, then discard the tuber



When the new shoots are about 10cm (4m, tall cut them out of the tuber retaining a small piece of tuber on each. Trim the leaves from the base of each cutting (see inset). Root 1-6 cuttings in a 5m (1 km) por

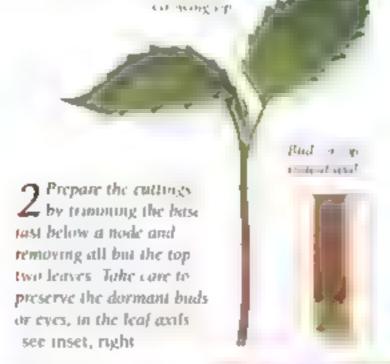
Insert the cuttings up to the leaves in a free-draining soil, such as equal parts coarse sand and peat (or peat substitute) and keep humid at about 66°F (19°C). When the cuttings show signs of growth, gradually reduce the humidity. Pot the cuttings singly in 3/in (9cm) pots in soilless mix. Harden them off (see p 45) before planting out.

Alternatively a tuber may be used as a stock plant to take several series of cuttings throughout the spring (see below). After lifting the tuber in autumn, pot it and keep in a frost-free place during the winter. Move it into a position with a minimum temperature of 50°F (10°C) in early spring to stimulate the dormant buds to shoot

### TAKING CUTTINGS FROM DAHLIAS



Bring overwintered tubers into growth in law winter Remove the first shoots when they are 3-4at (8-10cm) tall in early spring. Cut above the lowest node to leave a bild on the tuber



A keep the cuttings
of at a m n mam of
61% (16%) at night
lives she ild rown
2.3 weeks. When
their roots are well
developed one inser
pot the cuttings or
if weather permits,
plant out in their
tinal positions.



3 insert the cuttings singly into containers of soilless rooting medium. Here, they are userted into individual biodegradable pots. Firm them in gently, water, and label



5 a warm and mossi place. The remaining bads should produce a new flush of shoots Several batches of cuttings may be obtained from a stock tider at this way. The tider will penefit from a foliar feed if it is planted out

# DIERAMA ANGEL'S FISHING ROD, WANDFLOWER

Division in early spring or late summer \$ SEEOS in autumn \$

These evergreen cormous perennials can be divided but resent the disturbance so it is best to leave a plant until it is really congested. They must not be allowed to dry out when dormant in spring

The corms form in chains, as with Crocosmia (see p 264), and should be divided in the same way, with care after flowering. Replant the chains 4in (10cm) deep. They will be in the ground for some time, so make sure that it is well prepared and fertilized Divisions take 1–2 years to flower freely again.

Sow seeds (see p 256) when ripe Transplant the seedlings singly, grow on in a lrost-free place, and plant out the following spring to flower in 2–3 years.

# ERANTHIS WINTER ACONITE



Franchis avenues

Division in spring 1 Sectioning in spring 1 Sectioning in spring 11

These clump-forming perennials have knobby tubers. Many of the dry tubers sold in autumn tail to come into growth in spring. Damp-packed

Dividing tubers in the green (that is, immediately after flowering in spring and before the leaves die down) seems harsh, but it is successful. Treat the offsets as for Galanthus (see p 269). You may need to cut the tubers apart with a knife. They will flower in the following year.

Seeds ripen very quickly in spring and are soon scattered to form a colony If left to itself the common winter aconite. Eranthis hyemalis, will seed prodigiously to form large colonies. If allowing plants to self-sow in grass, do not clear away the first few mowings which may be full of seeds. To grow the plant elsewhere, gather the brown seeds as soon as the pods open. They need sowing immediately outdoors or in a pan (see p.256), to flower in 2–3 years

Sterne hybrids, such as E hyemalis Tubergenii Group 'Guinea Gold', may be sectioned if there are not many offsets Treat tubers as for Caladaian (see p 262)

### OTHER BULBOUS PLANTS

Dichetostimma (syn Brevoortia) Divide corms in late summer (see p 254) 4. Sow seeds at 55–61°F (13–16°C) when ripe (see p.256) 4.

# ERYTHRONIUM DOG'S-TOOTH VIOLET, TROUT LILY

Division to autumn !!
Seeos in autumn !

The bulbs of these clump-forming perennials look like long teeth. They do not tolerate being disturbed or drying out, so seeds are the best method of increase. Erythronium dens-canis self sows in favorable conditions. Mature clumps may be divided if necessary

Chipping has been recommended especially for species that offset very slowly, but it is not very practical because the tubers are so thin and the basal plates so small

### DIVISION

Choose a cool, damp day to divide the bulbs (see right) to ensure they do not dry out. Take care to note the position of the growing points, which are not always conspicuous. Replant the bulbs immediately or insert in deep pots contractile roots will draw the bulbs down into the soil mix. If they are out of the ground for any time, keep the bulbs in a plastic bag containing moist perfite or peat. Divided bulbs should flower in the following year.

forms of E. americanum are best planted individually because they are very quick to spread by means of underground stems (stolons)



DIVIDING ERVITIRONS MICHIMPS

The long turn buths of Erythromams form congested clumps. Left them carefully and tease out clusters of bulbs from the clump. Enrich the soil with well rotted organic matter. Replant the bulbs at the same depth, but 2cm.—in) apart.

### SEEDS

Gather the seeds from the pods when ripe and sow the seeds (see p 256) in pots of moist and rich seed soil mix (see p.34). The seedling bulbs grow quite slowly. They are best planted out as a potful (see below) when two years old in order to avoid disturbing their roots through repeated potting, and to avoid planting them upside down (their growing points are not obvious). They should flower two years later.

### TRANSPLANTING ERYTHRONIUM SEEDLING BULBS



Letow on seedling bulbs in the same por for two or three years. Then, when they are dormant, carefully slide out the entire mass of soil mix and bulbs from the pot



2 Plant the mass of buths into a prepared hed of moist, acidic soil, so that the top of the mass is at least I'm (2.5cm) below the surface and cannot dry out. Label and water.

# **EUCHARIS**

Division in spring \$

In warm climates, these tender bulbous perennials are evergreen and can be grown outdoors. Otherwise, a humid, warm greenhouse or house, and a large pot of soil-based potting mix, enriched by a weekly liquid feed, must be its home. Most are increased by division in cold climates because seeds are only occasionally produced.

Detach the offsets (see p 254), pot them individually, and grow on at 59°F (15°C) Remove any flower stems that form until the bulbs reach full size, with a diameter of about 3 in (8cm). After two years, the offsets should flower

Gather ripe seeds and surface sow at once in pots (see p.256). Germinate them at 77°F (25°C) with high humidity Transplant seedling bulbs in autumn They should flower after 3–4 years

# EUCOMIS PINEAPPLE FLOWER, PINEAPPLE LILY



Euromis bicolor

DIVISION in autumn or spring 1 Secos in autumn 11

The large bulbs of these unique-looking plants are best not divided until they are obviously congested. Divide any offsets (see p 254) and keep frost-free over

winter before planting out in spring, or divide in spring. They flower after three to five years

Sow the fleshy seeds (see p. 254) as soon as they ripen in soilless seed mix at 61°F (16°C). The seedlings grow rapidly and need regular potting to avoid checking their growth. Protect from low temperatures for the first two years

# GAGEA

Division in autumn | Boubles in autumn | Seeds in autumn |

Many of these bulbous perennials produce small offsets in profusion that can easily be detached and grown on (see p.254). They produce flowering plants in two years.

Some species, such as Gagea fistulosa, sometimes produce bulbils, instead of flowers, which fall to the ground in summer Others, such as G villosa, form bulbils in the axils of the basal leaves. Pick off the bulbils as they turn brown or collect them from the ground. Treat them as Itly bulbils (see p 273) for flowers in 2-3 years.

The seeds are quite small but are easily collected and sown (see p 254) Seedling bulbs take 3-4 years to flower Some, such as G lutea and villosa, self-sow in favorable conditions and make good subjects for naturalizing in the garden

# FREESIA

DIVISION IN AUTUMN \$

Numerous hybrids have been selected from the species of these cormous perenmals. They resent being disturbed while in full growth. When the foliage dies down, lift or repot mature corms and divide as for bulb offsets (see p.254).

Gather seeds when ripe and soak them in warm water for 24 hours until the seeds are swollen to soften the hard

seed coats before sowing in containers (see p.256). For optimum germination, keep them dark and provide bottom heat (see p.41) of 55–64°F (13–18°C). Once the seedlings emerge, which can take one or many months, pot them up individually and grow on at a minimum of 41°F (5°C) to flower within the year Seedling corms do not thrive if allowed to dry out or if exposed to temperatures much above 50°F (10°C)

# FRITILLARIA FRITILLARY



SEEDS IN AUTUMN |
SEEDS IN AUTUMN |
SCALING AND CHIPPING IN THE
SUMMER |
SCOOPING AND SCORING IN
HIC SHAMMER OF EATH
JUSTIMIN |

Erit ilaria meleugras Many fritillaries are quite hardy, except for

a few Californian species that will suffer damage below 41°F (-5°C). The bulbs vary greatly in size, from the diminutive Fritillaria minima to the very large F imperialis. Propagation depends on the size and type of bulb. F camschatcensis and Himalayan and Chinese species need to be watered during dormancy. New plants flower after three years.

### Division

Offsets vary greatly in size some are true offsets, as with F pyrenaica, and may be replanted direct after division (see p 254). Other species, for example F acmopetala, F crassifolia, F pudica, and F recurva, have tiny offsets, produced in abundance and best described as "rice." These are best grown on in containers as for cormels (see p 255).

### SEEDS

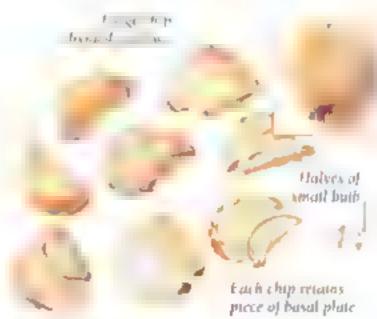
Some species self-seed readily and come true to type. Gather the papery winged seeds when ripe, and sow in the usual way (see p.254). They need exposure to fluctuating temperatures to germinate keep them at 28°F (-2°C) at night and 50°F (10°C) by day. Grow them on in containers for two years before planting

### SCALING AND CHIPPING

Scaly bulbs such as F camschatcensis lend themselves to scaling (see p 258) to form new bulblets. The scales may also be chipped (see right and p 259) for a larger number of bulblets. Chipping is useful for rare bulbs where crosspollination is impossible and no seeds are forthcoming. The number of scales or chips depends on the size of the bulb.

### SCOOPING AND SCORING

Lift large builts when they are dormant, clean off any soil or dead material, and check that each is not damaged or diseased. Scoop them as for hyacinths (see p 271) or score as shown below to encourage formation of bulblets. Treat the bulblets thereafter in the same way as for offsets (see above)



### CHIPPING FRITILI ARIES

Extillaria bulbs can be cut into wedges, or chips Cut larger, open-scaled bulbs (here Fritti aria unperialis) into eight or so chips and then divide each chip in two by cutting through the basal plate between the scales, Snap very small bulbs such as F acmopetala (see inset) in two

### SCORING LARGE FRITILLARY BULBS



I Hold the bulb (here of Fritiliana impenalis)

I upside down. With a scalpel, make two cids across the basal plate and base. Make the cuts the same depth as the basal plate and at right angles to each other. Dust with fungicide



2 Prepare a pot saucer or seed tray with a %in (2cm) layer of moist, coarse sand. Rest the bulb on the sand Label Keep in a warm, dry place. Bulblets should form along the cuts in 8-10 weeks

# GALANTHUS SNOWDROP

DIVISION IN Spring ( SEEDS in summer I TWIN-SCALING IN SUITIMET 11 CHIPPING in early summer 11

After a few years, these bulbs form congested clumps, so division is advisable to improve vigor. Seeds are produced only in mild weather that favors pollinating bees, some species self-sow freely in favorable conditions Forms and cultivars are numerous and often in short supply; large numbers of new bulbs may be obtained by twinscaling, Snowdrops also respond very well to chipping; this produces fewer new plants than twin-scaling but results in flowering plants more quickly. Water the bulbs even when dormant. New plants flower after three years

### DIVISION

Lift and divide clumps after flowering but while the leaves are still in growth or "in the green" (see above) These divisions establish more successfully

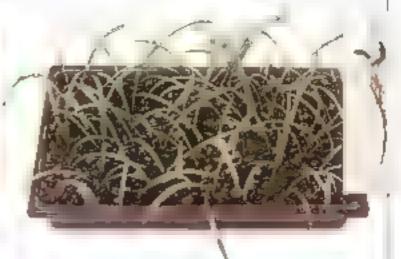


DIVIDING SNOW DROPS "BY THE GREEN" Lift clumps of snowdrops, taking care not to damage the roots, and pull the clumps apart Replant single builts into prepared soil at the same depth as before. Firm, label, and water in

The common snowdrop, G. nivalis, can be naturalized in woodland in this way

### SEEDS

To ensure germination, gather the seeds as the capsules split open. They should be sown immediately (see p. 256) to avoid the seeds becoming dormant and less ready to germinate. Double-flowered snowdrops do not set seeds



### TWIN-SCALING SNOWDROPS

One hill may yield up to 32 twin-scales. After bulblets form (about 12 weeks), they may be rooted (see inser) and overwintered in a deeptray in soilless potting mix before planting

### TWIN-SCALING AND CHIPPING

Divide the bulbs into pairs of scales (see p 259 and above) The bulbs can also be cut mto about eight "chips" (see p 259). New bulblets are best grown on in a lightly shaded nursery bed of organic soil outdoors, at a minimum of 28°F (-2°C) Alternatively, grow on the bulblets in deep seed trays or pots in a frost-free place for a year and then plant out

# GLADIOLUS

Division of autumn 1 SEEO8 in are summer 1 SECTIONING IN Summer 11

Only a few species of these cormous perennials are grown, but there are thousands of garden hybrids. Gladioli very readity produce cormels for division. Species can also be increased. by seeds and hypridize (see p 21) readily Any hybrid may be sectioned to preserve the form. New plants should flower in the second year

### DIVISION

Detach cormels from garden plants once the flowering stems have died back. Alternatively, plant stock corms shallowly in a nursery bed to obtain

greater numbers of cormels (see below) The cormlets may be stored indoors over winter, fined out in a nursery bed in spring, and grown on for a year before planting

### SEEDS

Gather the seeds and sow fresh (see p 256) in deep containers. Keep the seedlings in growth in the first winter by maintaining a minimum temperature of 59"F (15°C). Allow the young corms to die back in the following autumn, store them dry and frost-free overwinter, and plant them out in the following spring

### SECTIONING

Lift dormant corms and cut them into sections, as for Caladium (see p 262) Gladioli are susceptible to molds and rots, so always treat the cut surfaces. with fungicide, Grow on the sections as for cormels (see above)

# **GLORIOSA**



Rothschildsana

Civision in spring 1 SEEDS IN THE SPILE &

This single species, Gloriosa superba, has fingerlike tubers, which are produced in abundance All forms are tender Rooted tubers flower in two years, seed-raised plants in 3-4 years.

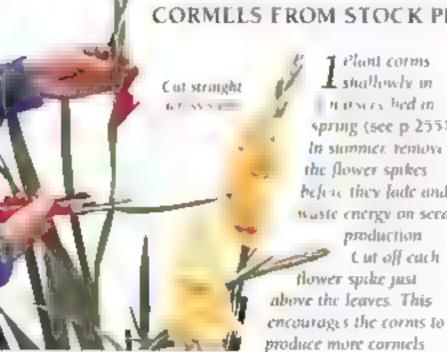
Take care when handling the tubers, because they can irritate the skin. The tubers multiply quickly. Divide them as for bulbous offsets just before growth starts (see p 254). Replant the tubers just below the surface of the soil or repot in soil-based mix with added grit. Grow on in frost-free conditions

50w in containers (see p.256) in seed soil mix combined with an equal part of sharp sand, and provide bottom heat (see p 41) of 66-75°F (19-24°C) Germination should occur in a few weeks

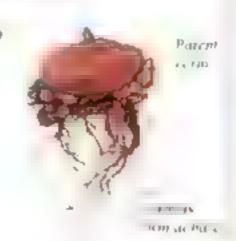
### OTHER BULBOUS PLANTS

Fi rraria. Divide comis in autumn (see p 255) L Sow seeds (see p.256) in autumn at 43-54°F (6-12°C) in bright light ## Galtonia Divide offsets (see p.254) in autunin when dormant I. Sow seeds when ripe (see p.256) in summer, keep frost-free for two years and water when dormant 1 HABRANTHUS Divide the few offsets (see p 254) when dormant 1. Sow seeds as soon as tipe (see p 256) at 61°F (16°C)





1 Plant corms £ shallowly in in itselfs hed in spring (see p 255) In stommer remove the flower spikes before they lade and waste energy on seed production Cut off cuch flower spike just above the leaves. This



In autumn, bft the stock Lorms. Gently detach all the cormels from each corm. Clean and store the cornicls over winter. then line them out to grow on

# HAEMANTHUS BLOOD LILY



SEEDS IN Spring (

DIVISION in early spring [

Offsets are produced slowly, so these tender bulbs can be divided only every few years Seed-raised plants flower in 3–5 years, offsets in two years

Harmings Comments

Keep evergreen bulbs just moist and deciduous species dry when dormant

### Division

Sideshoots sometimes appear before offsets are fully formed, but they can be divided in the second year Just as they start into growth, uncover the offsets and tease away from the parent builb. Pot singly in soilless mix with their necks just above the surface; use deep pots to allow the large roots room to grow. Keep in the pots until flowering, blood littles flower best when potbound.

### SEEDS

Extract the large seeds from the fleshy fruits and sow (see p 256) in sandy soil mix. Provide 61–64°F (16–18°C) bottom heat (see p.41). Water and feed the seedlings well to keep them in leaf for as long as possible and build up the bulb. When the leaves die, stop watering and keep dry and frost-free over winter.

# HYACINTHOIDES

BLUEBELL

DIVISION IN AUGUMN 1
SEEDS IN AUGUMN 1

In very favorable conditions, these bulbous perennials (syn. Endymion) seed themselves prodigiously. They are therefore easy to naturalize, but they can also become invasive. The storage organs are completely replaced annually the husk of the old bulb is found beneath the new one. New plants should flower in the following year

### DIVISION

Large clumps are often located at a considerable depth in the soil, so take care not to sever the stems when lifting a clump for division (see p 254). Once lifted, the numerous bulbs are easily separated. Replant them immediately, spaced singly 2in (5cm) apart, to cover a large area

### SEEDS

Gather the seeds when ripe, then sow immediately. They are best sown in large quantities in drills in a seedbed as for cormels (see p 255) and transplanted into their flowering positions two years later while they are dormant. Self-sown seedlings can be left to grow on in situ. The contractile roots soon pull the bulbs well below the surface.

# HIPPEASTRUM AMARYLLIS



H.ppeastron

Division of the writer of the early spring I SEEDS in autumn I CHIPPING to summer I

The 60 or so species of these mainly tender bulbs may be raised from seeds, but the many hybrids must

be divided to obtain true-to-type plants New plants flower in 2-3 years

### DIVISION

Lift the plants before they come into active growth and pull away large offsets (see p 254). Leave smaller ones attached to the parent bulb to bulk up until the following year. Pot the offsets individually in rich soilless mix, water thoroughly, and grow on at a minimum temperature of 55°F (13°C). They need good light to grow on, otherwise the stems become clongated. Water freely while in growth, but keep them dry and frost-free when dormant

### SEEDS

Sow the seeds when ripe (see above right) in containers (see p. 256) and keep at a minimum temperature of 61°F



HIPPIASTRUM SEEDREAD

The seedhead forms relatively quickly after the flower fades. Collect and sow the seeds as soon as they are ripe before they are dispersed

(16°C) for rapid germination. Pot the seeding bulbs when their leaves are 5-6in (13-15cm) long and grow on as for offsets (see p 255). Encourage them to rest in winter by watering less.

### CHIPPING

The large bulbs are an ideal shape for chipping (see p. 259) and can be cut into as many as 16 chips.

# HYACINTHUS HYACINTH

DIVISION in autumn 1

TWIN-SCALING AND CHIPPING in late summer 11 SCOOPING AND SCORING in late summer 11

Only cultivars of this bulbous perennial, Hyacinthus orientalis, are commonly grown. They must all be increased vegetatively because their color and vigor is the result of years of selection. The easiest way is by division of offsets However, hyacinths reproduce slowly, so various methods of cutting the bulbs may be used if no offsets are available. The rate of success depends on keeping the bulbs free from rot. Hyacinths are much hardier in the ground than in containers. New plants flower in two to three years.

### DIVISION

Lift and divide offsets when the foliage has died down. Dig down deeply around the clump, as for Roscoca (see p 276), because the offsets often lie deep in the soil. Throw the cleaned offsets onto the ground and replant where they land for a natural grouping. Allow the topgrowth to die away naturally. Water and feed the offsets regularly while they remain in active growth.

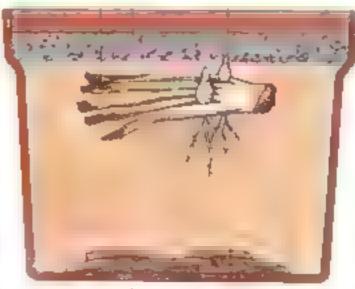
### TWIN-SCALING AND CHIPPING

In late summer, slice large bulbs into 16 sections. They can be twin-scaled or chipped (see p 259). Unlike other chipped bulbs, hyacinth chips do not rot away very readtly after the new bulblets form. When the bulblets have developed, therefore, pot the chips singly, placing them horizontally instead of vertically in the soil mix (see below), so that the old scales are completely buried. This will encourage them to rot away more quickly.

Old scales

Figure

Buddets beginning



Three parts peat to one part sand

### POTTING A RVACINTH CHIP

Once bulblets form place the chip horizontally in a half pot or pan of free-draining soil bits. Cover with sin (1cm) of mix and sin (1cm) of fine grit to ensure the chip rots off. Grow on for a year before repotting or planting out.

### SCOOPING AND SCORING

These methods involve wounding the basal plates. With the first, most of the basal plate is scooped out (see below). Alternatively, make deep cuts in the basal plate, as for fritillaries (see p. 268). When bulblets form, detach to grow on, or pot the bulb upside down in gritty soil mix, with the bulblets just buried. After a year, detach and grow them on

### **SCOOPING HYACINTHS**



I Scoop out the center of the basal plan of each dormant bulb, using a sterdized sharpened teaspoon or scalpel. Leave the outer run of each basal plate intact. Dap the cut surfaces in thoughouse to reduce the risk of rot.



2 Fill a tray or saucer with moist coarse sand. Set the prepared bulbs, basal places apperpiosi, into the sand-Keep them in a warm dark place, and water the sand occusionally as neep it domp.



3 After three months, butblets should form on the scooped basal plate. When they are large enough to handle, detach and set them in rows in a tray of soutess rooting medium. Cover with 101 (2.5cm) of medium and treat as seeds.

# HYPOXIS STARFLOWER



Hypoxis angustifolia

SEEGS in autumn or spring 1

These cormous perennials produce new corms annually, so they lend themselves to division. Seeds are useful if you require larger quantities of

plants for a woodland setting. New plants should flower after three years

Lift offset corms (see p 254). Replant the corms singly in free-draining soil or pot them in equal parts coarse sand and soilless potting mix. If necessary, protect them from late spring frosts

Gather seeds just as they begin to turn black in cup-shaped capsules, cut off the entire stalk as for Alstrocmeria (see p 260). Sow seeds (see p 256) at a minimum of 50°F (10°C) to ensure germination. Seeds may be stored at 41°F (5°C) over winter if needed. If attempting to transplant self-sown seedlings, take care not to mistake them for grass.

# **IPHEION**



Ipheion uniflorum Wisley Blue

Seeds in summer of spring !

ipheion uniflorum and its cultivars are the most commonly cultivated of these bulbous perennials. They are prolific, producing masses of

offsets. Some are tiny. Lift after the foliage has died down to divide (see p.254). This is the only way to produce cultivars true to type. New plants should flower after 1-2 years.

Gather the seeds in summer. Sow the seeds (see p 256) immediately or in spring in a sandy seed soil mix. Container-grown Ipheion often self-sow in plunge beds under cover; the straplike, slightly succulent seedlings are easily identified for transplanting.

### OTHER BULBOUS PLANTS

HERBERTIA As for Tigridia (see p.278. 1
HERBERTIA As for Tigridia (see p.278. 1
HERBERTIA Separate tubers in autumn
as for Juno irises (see right) 1
HYACINTHELIA As for Muscari (see p.2. § 1
HYACINT

# IRIS



hts magnifica

Division in au uran !
Seeds in laid suramen lo
autumn !
Chipping in laid summer !!

The bulbous perennials in this genus fall into three groups. Juno, Reticulate, and Xiphium inses. They have many

cultivars, which can be propagated only vegetatively. Juno irises are chipped, while Reticulata and Xiphium trises are best divided. All the species can set seeds, which come true. All bulbous irises die back after flowering and are summerdormant. New plants take three years to flower. (See also Perennials, p. 202.)

### DIVISION

Reticulate trises form tiny bulblets around the parent bulb, inside netlike tunics. This group of trises is prone to disease, so check the offsets carefully (see below). In areas with dry summers, plant the offsets outdoors, in other areas, pot them (see p.254). If large numbers of offsets are required, plant stock bulbs shallowly as for corms (see p.255).

### SEEDS

The large seeds are best gathered and sown (see p.256) as soon as they are ripe. They should germinate early in the spring as the parent bulbs flower Some trises, such as I reticulate or I winogradowit, form seed capsules at soil level, treat these as for crocuses (see p.265). They can be hybridized easily (see p.21); when selecting seedlings, choose them for vigor and form as well as color.

### CHIPPING

Juno trises can be increased by chipping (see p.259). Out the basal plate with great care to avoid damaging the fleshy true roots, which are only tenuously attached. A new bulb may also be grown from a root, if it is cut out together with a dormant bud on a piece of basal plate. Dust cut surfaces with fungicide and pot the root carefully in equal parts coarse sand and soil-based potting mix.



### DIVIDING IRISES

Reticulate irises, such as Iris histmo, are particularly prone to disease, so it is important to disease any bulbs that show signs of disease when dividing a clump of offsets

# **IXIOLIRION**

DIVISION IN MITUMEN 1
SEEDS IN AUTUMN 1

The small white bulbs of these perentials are readily increased from offsets (see p. 254). Seeds, which are produced in abundance, yield larger quantities of plants but are slower to reach flowering size, usually in three years. Gather the seeds as soon as they ripen and sow immediately (see p. 256). They usually germinate well in the following spring

# LACHENALIA CAPE COWSLIP



rach nu. r

Orasion of Lanst Concept

Land of Land Concept

Bother in late summer L

Seeds in spring or summer L

These bulbous perennials are native to South Africa. They are winter growing and, in cold areas

need excellent light conditions to keep growth compact and foliage markings attractive. New plants will often flower in their second year

Cape cowstips produce numerous offsets. Divide them after three years when the foliage dies down (see p 254). If potted or replanted in a mix of equal parts soil-based potting mix and fine grit, they will grow quickly

Some Cape cowslips, for example Lachenatia bulbifera (syn. L. pendula) produce bulbils (see below)

Gather the fleshy seeds as soon as they ripen and sow immediately (so p 256) in free-draining soil mix. The pan, once watered, needs to be kept just moist and at a minimum of 59°F (15°C) in bright light to ensure a good rate of germination. Pot the seedlings singly when they are large enough to handle Keep them in active growth over winter in a bright, frost-free place



CAPE COWSLIP BY LBUS
The hard, round buildis (here of Lachenalia buildicra) form in clusters at the base of the oid stens. Gather these once the leaves die down and treat as for kly bullils (see right)

# LEUCOCORYNE

Division in summer or autumn !
SEEDS in summer !

Offsets are not freely produced by these tender bulbous perennials, so seeds are a better method of producing new plants in quantity. New plants should flower after three years.

Lift and divide offsets (see p.254) at the onset of dormancy after spring flowering Replant or repot but keep them dry and rested until the end of dormancy, then water them to start them into growth in the late autumn, Keep them in active growth over winter, in bright light at 50°F (10°C)

Gather the seeds when ripe and sow immediately, barely covering the seeds in soil mix because they need light to germinate. Keep seedling bulbs well fed and watered and in growth for as long as possible. When they become dormant, allow the soil mix to dry out.

# LEUCOJUM SNOWFLAKE

DIVISION in late steerner to early agree visit.

SEEDS in late spends are a second agree 1

Some of these bulbous perennials prefer a moist, partly shaded site, smaller forms require sun and well-drained soil. The exact timing of propagation depends on whether the plant flowers in summer to autumn or in spring Lift mature plants when the leaves die down, and divide the offsets (see p 254). Alpine or dwarf species may be raised from seeds. For best results, sow fresh seeds (see p 256) in sandy soil mix alternatively, store the seeds at 41°1 (5°C) to keep them viable.



SNOWFLAKE IN FLOWER

Whether propagated by division or raised from seeds in set showleds at their Lencopum verticing various suggests as with the section 2-3 years

### OTHER BULBOUS PLANTS

LLOYDIA Treat as for Emillaria (see p 268) keep L serotina watered throughout dormancy 1

# LILIUM LILY



DIVISION in early spring or in autumn [ BULBILB in late summer [ SEEDS in autumn [ SCALING in a c saling of a Cuttings in late spring of a madeautimer [ ]

Lahama dabawana Except for hybrids of I thum longiflorum and

L. Jormosanum, and a few other species, the bulbous species and the thousands of hybrids are quite hardy. Not all groups of lines can be propagated in the same way. The garden hybrids can be raised only vegetatively, the method depending on the form and group of the hig, but care must be taken to use only virus-free stock. All species likes can be raised from seeds. It is slow and requires care but yields vigorous, virus-free plants. Some likes, such as Likum speciosum, do not tolerate lime and need to be raised in acidic soil mixes. All likes need to be kept moist throughout dormancy.

### DIVISION

Some species, notably L. speciosum in all its forms, produce offsets at the side of the large parent bulb that reach flowering size in 2-4 years. Detach these in autumn (see p.254) and grow on in acidic soil mix with equal parts of sharp sand in pots or nursery beds L. candidum flowers best in congested clumps, so divide only when necessary

Some likes, such as L. garatum
L. bulbiferum, L. canadense, L. fancifolium
(syn L. tigrinum), L. longiflorium
L. pantalinum, and L. speciosum, produce
rooted bulblets, usually below ground
at the base of the old flowering stem
Lift the bulb while it is dormant in
early spring to remove the bulblets (see
below). Pot the bulblets and piace in



INCREASING EILH 5 FROM BUILBLETS
Lift the dormant hidb and detach the bulblets
, see inset) from the old step: Replant the parent
bulb Prepare pans of moist, soil based poining
mix and insert the bulblets at twice their own
depth. Cover with a lover of grit, then laber

### COLLECTING AND ROOTING LILY BULBILS



Rape bulbils come away easily poin the leat axily. Select hearthy vigorous plants – bulbils can transfer doease. Throughout late summer pack the bulbils from the stems as



2 Fill a pan with moist soil based porting mix. Gently press the baloids into the surface. Cover with a in (Lim) layer of coarse said or time grit. Label. Grow on in a post-free place until the following aidin.

### ROOTING LILY BULBILS IN A TRENCH



Lift the bulb taking care to preserve the roots. Make a trench that slopes away from the bulb, work in some compost and coarse sand Lay the stem in the trench and cover so that only the tip is exposed

a shaded, frost-free place and treat thereafter as for seeds in pots (see p 256). Plant out in the following autumn to flower in 3-4 years. Alternatively, in early autumn, before the stems die back completely, wrench the stems out of the ground to avoid disturbing the parent bulb. Pot the bulblets or plant out in satu

### BURBLES

The tiny bulbils that form in the leaf axils of some lines root readily and produce a flowering plant in three years. Some species can be induced to form bulbils by disbudding just before flowering. Bulbilforming lines include L. bulbiferion. L. chaliedonicum, L. lancifolium (syn. L. tigrinum), L. leichtlinit, L. sargentiae. L. x testaccium, and some hybrids.

Gather the bulbils as they ripen (see above), root them in pans, then plant out the entire pan of young bulbs the following autumn. Alternatively, the parent lily may be buried in a trench alter flowering (see above right) so that the bulbils root along its length. Lift the young bulbs and replant in the spring

### SCALING

Most lilies, particularly the hybrids, are increased commercially by this method. It is quite easy for the gardener (see p. 258) if done in late summer so that good growth can be achieved before winter. Some species, for example L. pardalinum and L. washingtonianum have so many scales that they often shed scales naturally when lifted. L. martagon and other species from barsh climates benefit from a period of cold below 27°F (-3°C) to start the scales into growth

### SEEDS

Gather pale or brown seedpods, dry them, and sow the seeds fresh (see p 256). Lily seeds may be stored and sown in spring but will not germinate as well Seeds of some lilies, such as Lauratum L. candidum, L. henryi, L. japonicum, and L. martagan, germinate quite quickly but

appear dormant until leaves appear in the following growing season, this is hypogeal germination (see p 20). Keep the pots moist and lightly shaded for at least two years to check if seeds have germinated. The seeds will die if they dry out. Pot on seedling bulbs regularly to allow vigorous growth. They should reach flowering size in 4-5 years, Lilies also may be hybridized easily (see p 21)

### LILIES FROM LEAF CUTTINGS.



1 Select healths, newly matter heaves here of 1 thum long(florum). Evolv grasp each one close to the stem and gently peel it off so that it comes away with a "heel... Place the cuttings in a plastic bag to prevent moisture loss.

### CUTTINGS.

It has been discovered that a few lines can be grown from leaf cuttings, these include L longiflorion and L lancifolium and their cultivars. Pull off vigorous leaves after the filly has come into growth and treat as an herbaceous cutting (see below). Cuttings may also be taken in midsummer. Keep the cuttings humid but ventilate regularly and check for rot



2 Prepare a dilute fungicidal solution.
Wear latex gleves to avoid contamulating the cuttings and to proceed your state from the chemicals. Completely immerse each leaf-cutting at the social.



3 insert three cuttings in an 3m (8cm) pot of moist vermicable so that one third or each cutting is buried. Label and keep hantid and shaded at 59-64°F (15-18°C)



A la 3-6 weeks, the cuttings should root and hablets form at he bases. Tease the cuttings from the very cubic. Pot singly onto soilless poining may at the same depth.



5 Label the cuttings and water well. Keep them moist in a first free place in bright light to heep them in growth for a year below planting them out.

# Lycoris



Avenus. e tribe e

DIVISION t m. 11 SEEDS : r :

The perennial roots of these bulbous perennials resent being disturbed, so they are best propagated from seeds, although it takes longer (3-7 years after

sowing) to obtain a flowering plant Gather the seeds when ripe and sow them immediately (see p.256). Keep trost-free, ideally at 45-54°F (7-12°C), to ensure good germination

Division of offsets before flowering (see p 254) should be done with great care to avoid damaging the roots, and at will always set back the plants. It is better practice to top-dress and feed an established plant for many years rather than attempting to divide it

# MERENDERA

DIVISION IN Summer 1 SEEDS in spring of autumn 1

Offsets are freely produced by these cormous perennials. The plants flower very erratically, so be sure to divide by late summer before they begin to flower Break open the blackish tunics that encase the corms, then detach the cormels (see p.255). Pot them in freedraining soil thix and keep well watered while they are in active growth (but dry when dormant) to ensure they flower well in the following year

Since they form at ground level, the seed capsules are not obvious. Gather the seeds and sow as soon as they are ripe (see p 256)

# MORAEA PEACOCK FLOWER

DIVISION IN autumn 🛔 SEEDS IN JUNIOR OF SPINING

In spring and summer, these cormous perennials produce numerous shortlived trislake flowers in clusters. Some species can withstand temperatures to 20°F (-7°C) Tropical species require a manimum temperature of 12°C (54°F) In frost-free conditions, they can be evergreen. New plants flower in 2-3 years.

Cormels are freely produced. Lift the parent plants when dormant, or when growth is least active, in autumn Grow on the cormlets in containers or in nursery beds (see p 255), Gather the seeds when ripe; timing depends on the flowering season of the species Sow the seeds immediately (see p 256), they usually germinate very rapidly Transplant when large enough to handle

# MUSCARI GRAPE HYACINTH



Moscat negleamen

Division in autumn ! SEEDS IN applyment L

These bulbous perennials (syn Muscarimia) are easily grown In fact, they can be too successful as colonizers, and for this reason they need careful placement

### DIVISION

Numerous offsets are produced each year, divide them (see p 254) to start new colorues that will flower in two years

### SEEDS

Seed-raised plants do not flower for 2-3 years, but seeds are useful for alpines. such as Muscart comosum, that have few offsets. Species with large bulbs, such as M. muscarimi (svn. M. moschatum), have semi-permanent roots that resent being disturbed, these are also best raised from seeds, but may be left to self-sow freely Gather seeds in summer, sow (see p 256) in autumn direct or in nursery beds

# NERINE

DIVISION IN SPILING ! SEEDS IN ARBUMING I CHPPING in late summer 11

Some of these bulbous perennials are evergreen. Nerine bowdenii and its cultivars are useful as cut flowers. They are best left undisturbed and divided only when congestion affects flowering Some smaller nermes, such as N filifolia and N pudica, can be raised from seeds, larger bulbs are sunable for chipping

### DIVISION

Nermes form a solid mat of offsets after 4-5 years. Divide in spring (see right and p 254), not after the leaves the down, when the flower buds may be damaged. Lift a clump carefully separate out single offsets, and replant with their necks just showing, to flower within a year or two

### SEEDS

Nerine seeds germinate very quickly, often while still on the stem Keep a watch for the fleshy seed capsules forming on dying flower stems and

# NARCISSUS DAFFODII



NAME OF STREET ruptorla

Division in autenur L SEEOS in from face spring to early agrumn ! TWIN-SCALING AND CHIPPING in late summer 12

There are 50 or so species and thousands of cultivars of these bulbous perenmals. For

the gardener, division is the easiest method of increase. In fact, the bulbs can become so congested they rise up in a mound and must be lifted to maintain the flowering display

Twin-scaling or chipping may suit cultivars that are slow to increase, for example Narcissus pseudonarcissus subsp. moschatus (syn. N. alpestris): Seed-sowing is best for rare species. that need to be conserved

### DIVISION

Most daffodils increase naturally by offsets, large ones may be separated and replanted (see p 254) in soil improved with well-rotted organic matter to flower again in two years. Discard any old misshapen bulbs. Pot small offsets and grow on for two years before replanting them

### SEEDS

Gather seed capsules as soon as they split, from late spring to early summer Cut of the capsules rather than pulling them off, to prevent pests from entering

the parent bulb. Sow the seeds (see p 256) immediately in deep pots. Germination usually occurs upon the first rains in autumn. Keep the seedlings moist and frost-free Seedlings flower in 2-4 years. Species self-sow readily

Seedlings from naturally pollmated seeds or cross-polimated cultivars (see p.21) can be worthwhile. Daffodils are fairly easy to hybridize, because the stamens and stigmas are very accessible

### TWIN-SCALING AND CHIPPING

Daffodil bulbs consist of a series of broad scale leaves and are suitable for twin-scaling (see below and p. 259) if many new plants are required. Treat the Iwin-scales as single scales (see p 258) when growing them on

Chipping (see p. 259) is easier in preparation since it demands fewer cuts, but it produces fewer bulbs. A large bulb may be cut into 16 or so chips to flower in three years



TWIN-SCALING Cut a large dulfou.l. buth into 30 or more tivin scales. Once. publicts form on most of the tivin scales discard any faitures and pot the rest

### DIVIDING NERINE



Lift a mature clamp, digging deep to avoid damaging the biabs and roots. Separate the champ using back to-back forks, then carefully tease out single biabs from each piece.

gather the seeds as soon as they ripen Sow (see p 256) immediately, otherwise they will perish. Lightly cover the seeds with soil mix and germinate at a temperature of 50–55°F (10–13°C) Keep the seedling butbs frost-free, and do not allow the soil mix to dry out Pot them individually or plant them out after a year Seed-raised Nertine should hower in 3–5 years



2 Discard any diseased bulbs, then clean the healthy offsets. Replain the offsets at the same depth as before in prepared soil. Space them about 2in (5cm) apart. Label and water

### CHIPPING

Lift large bulbs in late summer and cut them into 16 chips (see p 259). Once the chips have started into growth and have been potted, water the young plants only when they are in active growth. Do not allow the dormant bulbs to become desiccated, however. Keep them frost-free until they are large enough to plant out after two years.

# Nomocharis

SEEDS OF Autumn 1 SCALING IN rate summer 11

This beautiful relative of the fily has bulbs that are scalv and easily damaged when moved but this does make them easy to propagate. The scales are very easily removed, after flowering but before the leaves die down, to produce new bulblets (see p 258)

If disease-prone stocks need renewing, new plants are best raised from seeds because seeds are unlikely to transmit the disease. Gather and sow the seeds as soon as they are ripe at 45–50°l (7–10°C) for the best results (see p 256) Keep the seedling bulbs well watered throughout the year; they should flower within four years.

# ORNITHOGALUM STAR-OF-BETHLEHEM

DIVISION III autumn I SEEOS III autumn I

Many of the European species of these bulbous perennials are quite vigorous one in particular, Ornithogalum umbellatum, is extremely invasive in many areas. The South African species are much less hardy. The chinchennches

O thyrsoides, is most commonly grown Olisets are freely produced and are white and almost greasy to the touch Leave plants undisturbed for three years, then divide after the foliage dies down (see p 254)

Gather the seeds from the flowering spikes when the seed capsules change

color from green to brown (see below). Sow them immediately (see p.254) to obtain flowering plants in 3-4 years. They can also be left to self-sow and build up a colony.

### RIPENING SPED CAPSULES

As the seed capsides ripen, the stem here of Ornithogalium nutses, gradually dies and falls in the ground covariage that the seeds spill safely onto the soil when released.

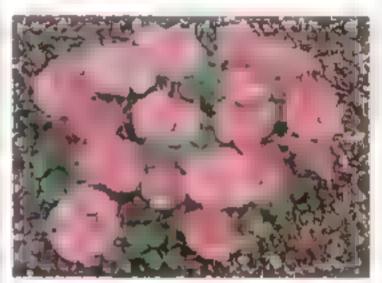
# OXALIS SHAMROCK, SORREL

Division in autumn | Seeds in autumn |

The storage organs of these plants may be bulbs rhizomes, or tubers. Like some of their herbaceous cousins, some have a highly effective means of seed dispersal and have become invasive weeds in some areas

The bulbs or tubers vary greatly in habit, size, and appearance. Some are scaly rhizomes, such as O enneaphylla, others have netlike tunics, such as O adenophylla, while some (O obtusa) are surface-growing. They all can be divided as for bulbous offsets (see p 254) to produce flowers the next year. (For how to divide nonscaly rhizomes, see Perennials, p 149.)

Some species, such as O. valdiviensis, have capsules that burst to scatter seeds, gather seeds as for Alstroenieria (see p 260). Choice species are more discreet, the seeds must be carefully gleaned from ground-level seed capsules. Sow (see p 256) at 55–64°F (13–18°C.) for flowers in 2–3 years.



ONALIS OBTUSA

This species spreads slowly, forming a mat. It sends out undergreeful stems, or runners, that produce both is. Lift these when do mont and grow on as for life bulbils (see p. 273).

### OTHER BUILBOUS PLANTS

Milla Separate corms (see p 255) when dormant J. Sow seeds (see p 256) in spring at 55–64°F (13–18°C), J.

NECTAROSCORDUM Sow seeds (see p 256) when uppe in autumn J. May become invasive if left to self sow.

Notificitition If bulbils are produced treat as for lines (see p.273) J. Sow seeds (see p 256) when uppe in late summer J.

Notificition Divide offsets (see p 254) when dormant in autumn J.

Panchatic M. Divide offsets (see p 254) when dormant, take care not to damage parent bulbs JJ. Sow uppe seeds (see p.256) in autumn at 55–64°F (13–18°C) J.

# **PAMIANTHE**

DIVISION IN WINTER ! SEEDS IN AUTUMN !

The deciduous Pamianthe peruviana is the only commonly grown species of this sometimes evergreen, bulbous perennial It requires a minimum of 50°F (10°C) and should never dry out but it does require a rest period in winter with reduced watering. New plants should flower in 3-4 years

The bulb is composed of large, fleshy scales, it spreads slowly by underground stems (stolons) that push the scales apart. Lift these scales and treat them as bulbous offsets (see p. 254) when growth is at its slowest in winter.

The seeds takes a year to ripen in the capsules before they can be harvested and sown. Germination is rapid if they are kept humid at 61-70°F (16-21°C)

# POLIANTHES TUBEROSI

DIVISION in automo 1 SEEDS in Automob 1

The tuperose Polianthes tuberosa has been cultivated for several centuries but is now lost from the wild in Mexico The tender tubers usually bloom only once but produce many offsets each year after flowering. Separate these when the tubers are dormant (see p 254) and replant in well prepared, very fertile soil the soil must be warm. Store offsets in a warm, dry place if needed until spring

Sow seeds as soon as they ripen at a temperature of 66-75°F (19-24°C) Provide the seedlings with a minimum nighttime temperature of 50°F (10°C)

# ROMULEA



baloac/duan

A widespread cormous genus, this includes European species such as Romulea bulbocodium (syn. R. grandiflora) and South African corms such as R macowanii

SEEDS in autonia 2

Nearly all are winter-growing and spring-flowering, so they may be potted and watered at the same time

In some cases, the offsets are almost as large as the parent corm and are quick to reach flowering size the next year if divided as for bulbs (see p 254).

The long seedpods retain the large brown seeds until well into autumn even alter ripening. Sow the seeds fresh see p 256) at 45-54°F (6-12°C) or outdoors under cover to ensure even germination in spring and flowers in three years

# ROSCOEA

OMSION in spring or autumn's L SEEDS in spring 1

At first glance, this genus appears to be nonbulbous, however, the roots are tuberous, and the plants are monocoty ledonous (see p 17) Roscoea withstand temperatures of -4°F (-20°C) if planted deeply. In wet areas, they are prone to rot, so protect them against heavy rain. Seeds produce flowering plants in 2-3 years, but some, such as Roscoca Beestana, are sterile and must he divided

### DIVISION

Roscoea may be divided in spring, but it is easier to do it just as the foliage turns color and begins to die back, as for an herbaceous perennial (see right) Separate the thin tuberous roots and replant the divisions in soil prepared with plenty of well-routed organic matter to flower in the following summer

### SEEDS

Gather ripe seeds in late summer or autumn (see below). Sow man edia exin warm climates or store 1 41 1 150 for spring sowing (see p 254) in cool climates. Germ nation is usually rapid and the seedlings can be transplanted into pots or a nursery bed in summer



RONG DE A SEE DELLAD The swelling seed capsides gradually weighdown the stems toward the ground. Cather the weds as soon as they turn verlowish brown

### DIVIDING A ROSCOEA CLUMP



1 On a cool, damp day, dig a trench at wasi I a spade blades depth around the plant there ex Beestand i to avoid damaging the fleshy roots. Lift the plant, using a fork



🐴 Divide a champ one sections, usos, back 🐷 L back forther) medical back section shours have good roots and 6-12 healthy graveth hads the old shoots in heate were to the buds are I



Cut away damaged roots and dead matter Dust the wounds with flangicide Replant the sections into prepared soil, but (15cm, deep and 6-12m (15-30cm) apart. Water and laber

# SCILLA SQUIL

DIVISION in early automotif SEEDS IN AUTOMIN ! CHEPPING in late summer 11

The European and Asiatic species of these bulbous perennials are quite hardy whereas South Africans are tender The bulbs are slow to form offsets and division (see p 254) is an easy, if slow form of increase. It is best done in autumn when divisions soon root, this applies to autumn-flowering species also

Scilla set seed readily, especially Scilla autumnale and self sow in favorable conditions. Seeds may be gathered in late summer and sown (see p.256) in autumn to germinate in spring and flower within three years. Leave selfsown seedlings in situ

Some species with large bulbs, such as Scilla peruviana, may be propagated by chipping. Slice the bulbs into 16 chips (see p 259) They flower in 2-3 years

SPARAXIS HARLEQUIN FLOWER

In the Northern Hemisphere, the corms

of harlequin flowers may be kept dry in winter and planted in spring, to

ensure they flower in summer and do

not revert to their autumns-to-withter

growth pattern. In mild areas, plant

them in autumn for spring flowers

In cold climates, delay sowing seeds

(see p 256) until spring, because the plants need warmth to grow. New

plants should flower within three years

Cormels are freely produced and can be separated when dormant (see p 255)

DMSION in late summer 1

SEEDS IN AUTUMN OF ITS SPRING !

# SINNINGIA

SEEDS in spring \{\}
"SECTIONING IS spring \{\}
BASAL STEM CUTTINGS in spring \{\}
LEAF CUTTINGS in late spring or early summer \{\}\}

Sunningia speciosa and its cultivars, commonly known as gloxinas, are tender tuberous perennials. They prefer a minimum of 64°F (18°C): in cold climates, store the tubers dry over winter. In growth, the tubers need warm, indirect sunlight and a rich soil mix. New plants flower within a year.

Surface-sow (see p 256) the tiny seeds on a peat-based seed soil mix. Keep in bright, indirect light at a minimum of 59°F (15°C). Pot the seedlings singly in a rich, soilless potting mix.

Seedlings are prone to fungal attack, so if only a few plants are needed, cut tubers into sections, before growth starts, as for begonias (see p 262)

To take basal stem cuttings, nestle some tubers, buds uppermost, into a tray in soilless poiting mix, so they are half-buried and almost touching, in early spring Leave in a light place at 64–68°F (18–20°C) for 2–4 weeks and



Taking Basal CUTTINGS OF GLOXINIAN Start Gibers into growth to obtain new shoots about ston (1-00) tall. Cut the most of the tuber with a clean-sharp hinte-retaining a small piece of tuber at the base of each catting (see suses)

keep the soil mix just moist. When shoots appear, take cuttings (see above) and pot singly in soilless mix with the tuberous "eye" just covered.

Cuttings of whole or part leaves (see below) may be taken. New tubers form at the base of leaf stalks or cut veins, some may fail to root and grow

SPREKELIA ALTEC LILY, JACOBEAN LILY

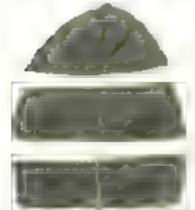
Division in late surpriser \$1. SEEDS in spring \$

The cultivated stock of the only species, Sprekelia formosissima, has become infertile but seeds have now been reintroduced from the wind. This tender bulb is dormant in winter.

A few offsets are usually encased in the bulb tunic. These can be separated (see p 254) in late summer and potted individually or lined out in a nursery bed. They resent root disturbance. Take care not to keep the dormant bulbs too dry or they will become desiccated. On the other hand, if they get too wet, they will rot. Offsets will flower in 2-3 years

If available, sow seeds (see p.256) when the threat of frost has passed. In warm climates, seeds should germinate freely if sown fresh

### GLOXINIA LEAF CUTTINGS



I Scheet a mature beat that is as flat as possible. Cut it from the prant. Use a clear scalpel to divide the leaf into transversa sections, each about 1 in clear) wide that fill a seed tray with a soil may such as equal parts pear and sharp sand or perlin.



Carrings should

not touch

2 fay the cuttings flat on the soil mix surface Secure with war hoops over the main verus to keep the cuttings in close contact with the soil my Label, water, and cover to keep bound.

Smale taker from a ad 1) main ve n



3 Keep the cidings out of direct sunlight at a temperature of about 64% (18%) in 3-4 weeks, tony takers should begin to form. Allow the old leaves to rot away naturally, then pot the adders of twice their own depth to grave on

### WHOLE LEAF CUTTING



Remove a leaf with its stalk and a small piece or heel, of the mater stem at the base. Piece is repright in a prepared port so that the leaf sits on the surface. Label, water and cover with a plastic bag held clear of the leaf with split stakes. Treat as in step 3

### OTHER BULBOUS PLANTS

PUSCHMINIA As for Chronodoxit (see p 26.3) § RHODOHYPOXIS Divide tubers in spring (see p 254) §. Sow seeds at 45°F (7°C) in spring §

SAUROMATUM Separate offset tubers when dormant in winter (see p 254) { SCADOXUS As for Hacmanthus (see p.270) }

# STERNBERGIA AUTUMN DAEFODII

DIVISION in face summer or carry autumn | SEEOS in autumn to spring | CHIPPING in summer | | |

The bulbs of some species flower best in mature, congested clumps, so divide them only when necessary. The bulbs are dormant only for a short time in them to divide the offsets (see p 254) and pot them or grow them on in a nursery bed in a sunny site. New plants take 3-4 years to reach flowering size.

The best method of increase is from seeds, which are produced in capsules at soil level. Sow the seeds (see p 256) at 55–61°F (13–16°C) as soon as they are ripe to germinate in the first autumn

One species in particular, Sternbergia candida is rare in the wild and not quick to multiply. Chipping (see p 259) is a way of bulking up rare stocks more quickly. Cut each bulb into as many as eight chips.

# TECOPHILAEA CHILEAN BLUE CROCUS

DIVISION IN THE SUMMER ! Seeos in late summer 1

The two species of cormous perennials are thought to be extinct in the wild They need frost-free conditions in winter when in growth, during summer dormancy, they must be kept barely moist. They take 2-3 years to flower

Lift the corms and detach the cormels to grow on (see p.255) The more tender Tecophilaea violiflora must have complete frost protection (see pp 38-45)

Tecophilaea rarely set seeds in cooler chmates. Although they are not rare in cultivation, the corms are costly. It is therefore worth the effort of handpollmating the flowers in spring to ensure seed set

Gently brush a soft paintbrush over the central stamens of every flower to transfer the pollen from one flower to another Sow the seeds (see p.256) in frost-free conditions as soon as they ripen, they germinate quite quickly

# TIGRIDIA PEACOCK FLOWER, TIGER FLOWER

DIVISION EXSPERS OF TAXABLE PARTY SEEDS IT SPECIAL

Ligitidia pavonia and its cultivars are the most commonly grown of these tender bulbous perennials. They are prone to viruses, so seeds provide a way of avoiding disease if necessary

### DIVISION

Divide the bushs (see p 254) every 3-4 years in spring or, in cooler climates where they are overwintered under cover, in autumn. The offsets vary in size, replant larger ones with the parent bulbs to flower in the same year. Take care to discard any offsets that have heen affected by viruses. Pot smaller offsets or line them out in a nursery bed as for cormels (see p 255), to grow on

### 5FFDS

Gather the seeds in summer and sow (see p 254) fresh in warm areas or in spring in cold climates at a minimum of 59°F (15°C) Keep seedlings moist, and in bright light shaded from hot sun, to flower within 2-3 years



LIGRIDIA PAVONIA SEEDHEADS

Ous species produces long, upright seedpods in late summer. The wind shakes the brown ripened pods, which then scatter seeds like a sait shaker.

# TRITELEIA



Peter Peter

laxe

DIVISION in early autumn 1 SEEDS in autumn I

In dry, warm summers, the cormous perennials in this small genus will self-sow to some extent. New plants should flower within 3-5 years

### DIVISION

Separate offset corms when dormant as for bulbous offsets (see p 254). The offsets may have several layers of fibrous coats, discard older layers, but do not denude the corms completely

### SEEDS

Seeds are best sown as soon as ripe (see p 256) at 55-61°F (13-16°C) Transplant seedlings 18 months later into a raised bed with very free-draining soil

# Tritonia

DIVISION in augumn 1 SEEDS in autumn or in spring 1

Tritonia have affinities to Crocosmia but are generally more tender. They are very easy to please. Cultivars must be divided to maintain the stock, but species come easily from seeds. New plants flower in two years

### DIVISION

The plants are in active growth in winter, so they should be lifted and divided in autumn. The corms are produced in chains as with Crocosmia separate them in the same way (see p 264)

### SEEDS

The small black seeds can be sown as soon as they ripen in equal parts soilbased seed mix and coarse sand at a temperature of 59°F (15°C) If this is not possible, store the seeds in a cool dark, dry place and delay sowing until spring

# TROPAEOLUM



Division in carry spring 11 SEEDS in spring 1 CUTTINGS in spring 11

Many of the tuberous perennials in this genus are tender, although a few are hardier Seeds are easy but not always available in cold areas. (See also Annuals and Biennials, p 229.)

# DIVISION

Dapacolum

polyphyliam

The tubers can be very large and deeply set in the ground, with spreading clumps and threadlike shoots that travel some distance below the surface before emerging. Lifting and dividing offsets can be quite a tricky task

Before the delicate shoots start into growth underground, lift the dormant tubers and very carefully separate as for bulbous offsets (see p.254) Replant the oilsets at the same depth as the parent tuber to flower the next year. If growing on tubers in containers, use deep pots

### SEEDS

Pick the large, fleshy seeds from the cuplike capsules. Store over winter and sow in spring (see p 256) in frost-free conditions. Germination is often erratte Seed-raised plants flower in three years.

### CUTTINGS

The tubers of T polyphyllum lie very deep in the soil, so lifting them is quite a chore. Instead, take stem-tip cuttings as for herbaceous perennials (sec p 154)

# TULBAGHIA

DIVISION IN spring \$ SEEDS in late stimmer or in spring 1

The bulbous or rhizomatous perennials are clump-forming and usually deciduous, although some are semievergreen. They are mostly summergrowing and are vigorous plants that benefit from regular division to maintain them at their best. Turbaghias do not seed freely in cold chimates

### DIVISION

Tease apart bulbous clumps in spring. even if they still have some foliage, and pot them to grow on (see p 254)

### SEED

Gather the secuheads in late summer and dry to extract the seeds. These may be sown (see p.256) as soon as they are ripe. Stored seeds are best sown in the spring to avoid any danger of frost The seeds germinate very readily in a few weeks, and seedlings often reach flowering size within two years

Watsonia corms are generally hardy to

about 20°F (7°C) They are scarce in

of corms, similar to Crocosmia, and

species before the first frosts, divide

them and store dry over winter then

replant in spring If large numbers of

corms are required, plant stock corms

shallowly in a nursery bed (see p 255)

Gather them when ripe and store until

(13-18°C), keep the seedlings frost-free

autumn. Sow (see p 256) at 55-64°F

The seeds are produced in long pods

They flower in three years

commerce; seeds may be the only option

Watsonia form clumps with chains

are divided in the same way (see p. 264) In cold climates, lift summer-flowering

# TULIPA TULIP

Division in automo ! Seeds in automn !

The thousands of cultivars of this bulb are best divided, especially because many are lifted and stored dry during summer in cool or wet areas. The 100 or so species come true to type from seeds, but some patience is needed since seedling bulbs may take six years to flower

### DIVISION

The ideal time to separate the offsets (see p 254) is when the bulbs are lifted to be stored dry in a tray over summer Commercially this is still practiced, although tissue culture (see p.15) is now used for new cultivars. In some species, offsets form on the ends of roots directly beneath the parent bulb and sink into the soil ("droppers"), so take care when lifting them Replant offsets too deeply -8in (20cm) – rather than too shallowly or they may not flower. Plant shallowly as for corms to promote offsets on stock plants (see p. 255), or cut small notches into the basal plate to encourage offsets



### WILD TILLIPS

to the wild, talips where Tubipa techningamica. grow in soil that is baked in the heat. When dismant, some tidips must be kept completely dry

### SEEDS

The papery, winged seeds are best sown in autumn and need a period of cold to germinate evenly. Tulips bybridize easily (see p.21) Most cultivars are sterile or produce few good seedings



Watsonia

DIVISION III spring

SEEDS IN autumn I

Division in spring (evergreen species) II or to autumn preciduotes son testal

perenmals, Zephyranthes candida is the hardiest. surviving temperatures to 20°F (-7°C). They

are commonly known as rain or wind flowers. Evergreen clumps flower best if left undisturbed but must be divided eventually. Deciduous offsets are more easily divided. New plants flower in TWO YEARS

# ZEPHYRANTHES

SEEDS IN Seeing or abilition 1 Among these bulbous

### 1775 CF 11. 5 - - -

### DIVISION

When an evergreen clump such as of Z candida becomes congested, it is best lifted and divided (see p.254) before active growth begins, in much the same way as for herbaceous perennials (see also Roscoea, p 276) Divide deciduous spring-and summer-flowering species once they begin dying down in autumn

### SEEDS

The large, flat, black seeds persist for a long period in the capsule. Gather them when ripe, this varies from spring to autumn, depending on the species and level of rainfall. Sow the seeds (see p 256) in spring at 55-64°F (13-18°C)

### OTHER BULBOUS PLANTS

Zigadenes Divide hulbs (see p 254) when dormant in late autumn or spring 1 Sow seeds (see p 256) when ripe or in spring at 55-64°F (13-18°C) 1.

# Veltheimia

DIVISION IN Italianin 1 SEEDS in automit or spring I CUTTINGS in late an arms 11

The two large bulbous perennials of this genus are tender. They are summerdormant, and young plants need long bright days to grow well, this is not always easy to achieve in winter in cool climates. New plants can flower within .hree years

Veltheimia resent being disturbed, so wait until flowering diminishes, then divide the offsets (see p 254) Replant

them in sandy soil or equal parts soilbased potting mix and coarse sand Make sure that the top of the "necks of the offsets are exposed

bow seeds (see p. 256) at 66-75°1 (19-24°C) singly in pots. Use deep 1 ain (3cm) pots to allow the seedling roots space to grow away quickly

Mature leaves may be treated as cuttings (see below). Once bulblets have formed carefully tease them out of the soil mix and pot up singly. Grow on in shade at 41-45°F (5-7°C)

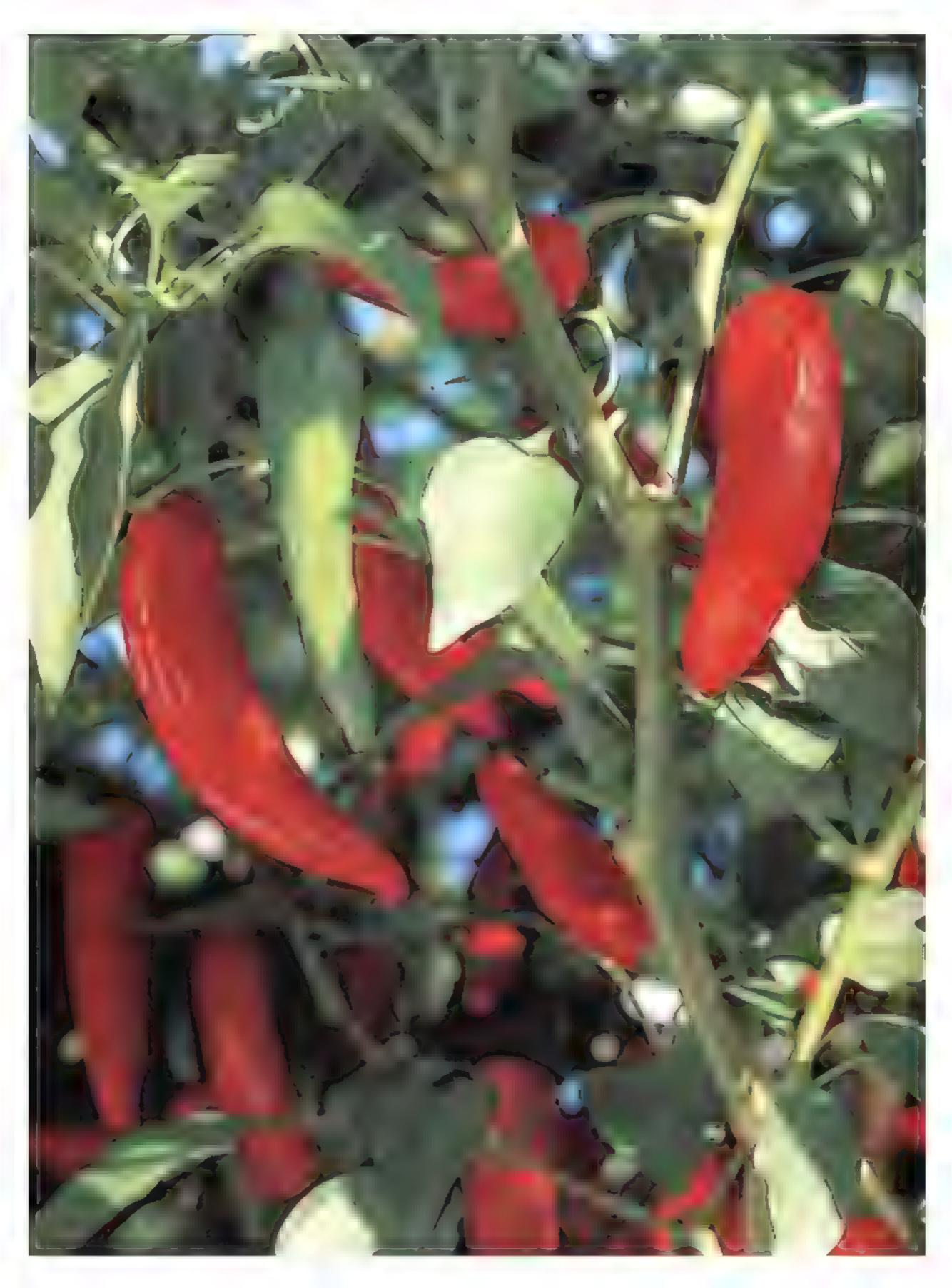
### TAKING VILTHEIMIA LEAF CUTTINGS



lake a newly mature leaf there of Velthermia L bracteata, syn. V capensis) Cut through its base with a scalpel or sharp knife taking cair not to cut into serves bereath. If desired cut to c leaf into Li-, in (3-6cm) sections



Till pots or trays with moist sliggy sand o acqual parts potting nux and vermiciante or true grit. Insert the cuttings vertically, just deep nough to stand up. Keep humid at 68°F (20°C) not 5: 10 weeks until bulblets form





# VEGETABLES

As well as the excitement of raising a new plant, propagating vegetables brings the added reward of an edible harvest, often within a few months. To flavor your vegetables and other dishes, stock the garden with culmary herbs

Vegetables may be perennial biennial, or annual plants, but most are grown as annual crops. The principal, and generally easy, method of propagation therefore is from seeds, which may be sown in various ways, depending on the crop and the climate. The traditional method of sowing vegetable seeds outdoors is in drills in a separate vegetable plot, but they may also be sown in deep beds to avoid the need for digging, in containers, or in informal patches in an ornamental kitchen garden. Some methods of seed sowing, such as fluid-sowing and intercropping, are peculiar to the propagation of vegetables.

Vegetables are usually sown direct or transplanted as seedlings into their permanent site. It is therefore particularly important to provide the optimum soil conditions for the best possible crop. This involves preparing the soil, rotating crops to avoid buildup of pests and diseases, and sowing appropriate cultivars for the required harvest time. Vegetables may be classed as cool, temperate, or warm-climate crops; sowing times will vary depending on the climate.

Some vegetables, such as asparagus and cardoon, are perennial; these may be propagated by other means, such as cuttings of various kinds, division, or grafting. Tuberous vegetables, such as

RED-HOT CHILL PEPPERS

Eigh peppers such as this Capsicum annount Hot Mexican' cross-pollmate more readily than sweet peppers, so it is advisable or grow point plants at least 70 ft (20 meters) apart from other cidivars, Gather seeds from fully ripened fruits potatoes or Jerusalem artichokes, are generally increased from seed tubers, in some cases, specially bred seed tubers are available that are certified free of viruses to ensure a healthy crop

With some vegetables, such as lecks, it is worth allowing a few plants to go to seed to sow next year. Some vegetables cross-pollinate freely, but others will come fairly true to type from homegathered seeds; many are specially raised hybrids that produce inferior results if grown from gathered seeds

Culmary herbs (see pp 287–91) are cultivated in much the same way as other herbaceous or woody plants and so may be propagated in a number of ways, depending on the plant. Annuals and biennials must be raised from seeds; herbaceous perennials may be increased from cuttings or by division; woody herbs may also be layered

Pi MPKINS AND SQL AMIES
This diverse group of annual
vege anies is easy to
press are to If the seeds
and to be gathered
hand pollimate the
female flowers
and remove male
flowers to prevent
cultivars from
cress port reating
Squash and pumpkin
seeds must be fully mature
to ensure germonation

# SOWING SEEDS

Most vegetables are grown as annual crops and therefore are raised from seeds, generally with good results. Many F1 hybrids are produced by crossing two selected parents. The hybrids are more vigorous, produce larger crops, and may be of superior quality to open- or naturally pollinated cultivars. Research in recent years has enabled resistance to pests and diseases to be bred into many cultivars, although quite a few people feel the flavor has been sacrificed. For this reason, many gardeners grow the so-called "heirloom" cultivars, all of which are open- or naturally pollinated and use natural, "organic" methods for controlling pests and diseases

### BUYING VEGETABLE SEEDS

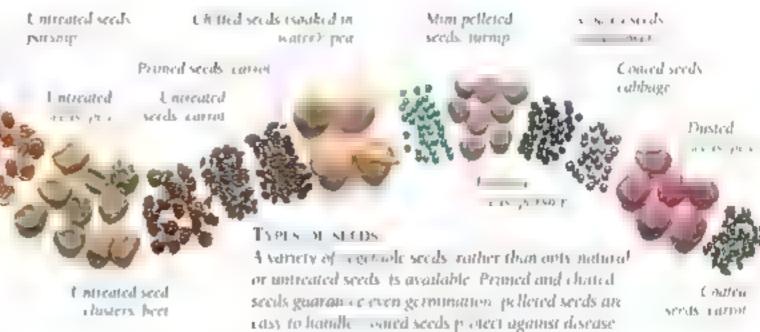
Always buy seeds that have been stored in cool conditions and are preserved in scaled packets. Commercial seeds are tested for viability, cleanliness, and purity before reaching the consumer. They are available in a variety of forms although primed and chitted seeds may be difficult to find.

Untreated or "NATERAL" SEEDS. These have simply been harvested, dried, and cleaned. They generally vary in size and are sometimes graded into specific sizes for drilling, using seed sowers (see p. 28). Printed or "sprinter" seeds. These are specially treated to germinate 1–2 weeks earlier than natural seeds. Primed seeds are also larger and easier to space along a drill or sow individually in containers.



DRYING SEEDPURS

in damp crimates, pult up stems with seedpods
where beaus) and hang them by their roots in an
airy, dry, frost free place. Once dried, remove the
pods and extract the seeds.



They are ideal for sowing early carrots or parsnips when conditions are poor Chilten (sprot tip) selbs. These are pregerminated and sold in small plastic containers to be sown at once in pots or trays. They are useful for seeds that are difficult to germinate. Any seeds may be pregerminated at home (see p 284) to give them an early start.

Priterio steps. These are coated with clay to form small balls and are easier to handle than untreated seeds, particularly small seeds such as those of cabbages, carrots, and caulillowers. They are often treated with a fungicide or insecticide Pelleted seeds need moister conditions than untreated seeds to break down the coatings so the seeds can germinate Coated and by steps. These are treated with fungicide. As with all such seeds, wear gloves or wash your hands after sowing.

### GATHERING SEEDS

Instead of buying seeds, you can gather them from plants in your garden. Fl hybrids do not come true to type, but gardeners who are not concerned with uniformity can experiment with open-pollinated seeds. Some vegetables are more worthwhile from home gathered seeds than others (see A–Z of Vegetables, pp.292–309)

Some vegetables are self-pollinating, while others need to be cross-pollinated in the garden, there will be a certain amount of natural cross-pollination, so self pollination is never 100 percent. To ensure purity of seeds, either grow only one variety of each vegetable, or isolate the different varieties of self-pollinators from one another Brassicas and corn can be grown for seeds only in large quantities. Each variety must be grown in a large block — about 50 plants for brassicas and 100 plants for corn — to ensure the purity of the seeds

Some vegetable seeds, such as carrots, parsley, and parsnip, can be sown immediately after they ripen,

whereas others, such as beans, squash, tomatoes, and corn, must be stored. Allow the seeds to ripen fully before harvesting. Gather seeds in pods while still on the stalks and dry them thoroughly (see below, left). Seeds contained in fleshy fruits need to be cleaned before drying. Some seeds may need special treatment (see A–Z of Vegetables, pp. 292–309).

### STORING SEEDS

Seeds deteriorate with age, losing their viability and vigor, which results in pooter germination and reduced yields if stored, they are best preserved in cool, dark, dry conditions at about 34–41°F (1–5°C) never in a kitchen drawer or garden shed. Store the seeds in paper packets in an airlight container or in airlight jars, labeled with the plant name and harvesting date. Reseal foil packets with tape after opening.

Before sowing, test the viability of seeds by placing 50–100 seeds on moist paper towels in a warm, dark place. Keep them moist and check daily for germination it should be at least 60 per-cent for viable seeds. If it is low, sow the seeds more thickly than usual

### **CROP ROTATION**

When planning your vegetable garden, group vegetables into the following categories, alliums (onion family), brassicas (cabbage family), legumes (beans and peas), solanaceous crops (peppers, potatoes, and tomatoes), and umbelliferous crops (carrots, parsnips). Sow vegetables from each group in a different site every 3-4 years (every 1-2 years in a small garden), to avoid a buildup of pests and diseases in the soil. This is especially important with alliums or brassicas.

### WHERE TO SOW VEGETABLES

There are two principal ways of growing vegetables, in rows or in beds. Vegetables have traditionally been grown in spaced rows, or "drills," in rectangular plots, this

### THE RAISED OR DEEP-BED SYSTEM

A deep hed improves the soil so that it is possible to sow up to four times as densely as in a conventional bed. Caltively the ground deeply and dig in organic matter. Mark out the area of the bed: it should be a more than 5ft (1.5m) wide to allow easy access without wathing on the soil. Motord the surface, using topsoil from another area, so that the bed is suchtly raised.



System is best if a large crop is required. Nowadays the bed system, with vegetables spaced equally in narrow beds lined by paths, is more popular. The benefit of his system is that only the actual bed needs to be dug, manured, and fertilized not the soil in between. Also, all of the work can be done from the paths avoiding soil compaction. Raised beds (see above) warm up more quickly in spring and give greater yields because crops can be grown closer together.

### PREPARING THE SOIL FOR SOWING

Most vegetables prefer a well-drained moisture-retentive slightly acidic soil and one that is rich in nutrients, especially for long-term crops. Choose a sheltered but not shaded site. Thoroughly dig the soil in autumn, adding pichay of well is tied organic matter, such as manure or compost. Do not sow any root crops (except potatoes) on freshly manured ground, because they will produce forked roots.

In spring, loosen up the soil and add fertilizer. Normally, a balanced one of nitrogen, phosphorus, and potassium (potash) is used for vegetables, but certain crops have specific needs, such as lime for brassicas.

Just before sowing, rake over the soil to give a smooth, loose surface, known as a "fine tilth". This allows seeds to be sown at a consistent depth and to obtain the oxygen essential for germination. Heavy, wet sons are cold and lack oxygen if possible, wait until the soil is workable before sowing or transplanting seedlings. If the soil is wet stand on a board to avoid compaction. Dry soil is also a problem (see brlow), since water is needed to enter the seeds and moisten the seed embryos for germination.

Most vegetables need soil at a minimum of 45°F (7°C), to germinate Some, such as corn and squash, require higher temperatures, while others such as cabbage or lettuce, will not germinate if the temperature is too high. Some will bolt, or go to seed, if sown at the wrong time of year. See 4–Z of Vegetables, pp 292–309)

### SOWING SLEDS IN STANDARD DRILLS



Mark out a tow with a stress, time and pegs, or with a stata tise the corner of a line to done out a small even drill in the soil to the depth required for the seeds.



2 See con control of 1
compare of a son Species
the seeds to one and even a story
the drift—or the seeds with soil
willight discovering them. While in

### SOWING IN DRY OR WET SOIL



DRY CONDITIONS When the selection of the drift first, then selection seeds and cover over with dry soil



WET CONDITIONS If the soar disans slowly or is very heavy sprinkle crayer of sand in the dr (I before sowing the seeds

### SOWING SEEDS IN A WIDE DRILL



I bake a concord of age to to add you, applying a light and compressure. Mark out parallel doubs 6-901 (15-23cm) wide at the required depth for the seeds



2 Special and some time the and some rates and Make sure than to regard a depending to a chest size.



3 saterals over the seeds with self seeds with the force a rake or draw the soft over gents with variable. Take care not a draw the seeds. While in well



4 Protect the seeds from birds of Joraging animals if necessary or pegging wire netting over the row Remove the netting before the see things grow through the mesh

### FLUID-SOWING PREGERMINATED SEEDS



Pregerminate the seeds on moist absorbent paper As soon as they have swelled and have begun to sprout wash the seeds carefully into a face-meshed sieve undergently running water



2 Mix up so we wallpaper passitive the art to alc) in a fartive about 80 and of pastifor 100 seeds. Tap the seeds a the far and sto ands to distribute the pasticular of the pasti-



3 a by the post to a plastic bug and knot the peace of the Snip off one of the bug and the bug as to be aver a snip to be but and the bug and the bug



A Genaly squeeze a tine of paste and seeds into the drift Label the drift, then carefully draw the sec over the seeds with the hack of a rake to cover them. I wash by lightly raking over the soil surface

### FLUID-SOWING PREGERMINATED SEEDS

Crops such as beets, earrots, and parships need a higher temperature for germination than their seedlings need for growth. In colder climates, this may affect the yields of spring sowings. To obtain a reliable germination rate, seeds can be pregerminated, or chitted, and then fluid-sown. First the seeds are scattered on damp paper towels in a saucer or seed tray indoors at 70°F (21°C). They usually germinate within 24–48 hours, depending on the crop

The seeds can then be mixed with a clear gel, such as water-based glue or wallpaper paste, before sowing in drills (see above). Do not use wallpaper paste containing fungicide, which may kill the seeds. Sow when the seed roots are no longer than sin (5mm), or they may be damaged during sowing. Gel helps keep the seeds moist until they root, but the soil should still be watered if needed in the first 2-3 weeks. The seedlings develop more quickly with this method.

### SPACE-SOWING AT STATIONS



seeds should be sown, draw more drills at right angles to the first set. Sow 2–3 seeds at each atersection or "station." Water in and label

### SPACE-SOWING AT STATIONS

This method of sowing has become popular because it reduces the amount of thinning necessary, makes more economical use of seeds, and avoids the need to transplant crops that may suffer a check in growth if toot disturbance occurs at the seedling stage.

To station-sow, drills are made at the correct spacing and depth for the crop The "stations" at which to sow the seeds are measured out, either by drawing out more drills (see below left) or by making shallow holes along each original drill

### BROADCAST-SOWING

Some crops, such as carrots or radish may be broadcast-sown over a well-prepared seedbed (see p 32), rather than into drills. This method makes efficient use of space and may be used for early sowings into a cold frame or a plastic-film tunnel (see p 39) in colder climates

Because the crop will be difficult to weed, it is preferable to broadcast-sow outdoors onto a stale seedbed, where weed seeds in the soil have been allowed to germinate and then heed off before sowing a crop (see p 32)

If the seeds are very small, they can first be mixed with some fine sand to ensure even distribution. Once sown (see right), the seeds should not be covered too deeply; if they are too far down in the soil, they may not before they have a chance to germinate

### THINNING SEEDLINGS

Seedlings must be thinned at an early stage before they become crowded and compete for light and moisture. Thin in two or three stages, taking out the weaker or damaged seedlings each time so that the leaves of the remainder gradually have more room to grow. At the last thinning, the seedlings should

be left at the spacing recommended for mature plants (see A–Z of Vegetables, pp 292–309). This method avoids any gaps opening up if some seedlings die off in the meantime.

Seedlings of crops such as cabbages lettuces, or onions may be lifted for transplanting. Firm the soil again by giving the seedbed a good watering

### MULTIPLE-SOWING TECHNIQUES

Seeds of two or more crops may be sown together to maximize use of the available ground (see facing page). A fast-growing crop is generally sown between a slower-growing crop so that

### BROADCAST-SOWING



Prepare and water the seedbed then when the surface has dried off rake it to create a fine 10th throadcast the seeds by scattering them think and evenly from you hand or a packet over the surface



2 Cover over the seeds by lightly drawing the rake over the soil at right angles to the in ginal direction of raking. Use a watering can with a fine rose to water the seedbed thoroughly Label the seedbed.

### THINNING SMALL SEEDLINGS



Thin small seedlings by impping them out at the base of the stem between finger and thimb, or use seissors. This avoids disturbing the roots of the other seedlings. Thin enough to leave a lath-lear space between the seedlings that remain

one crop can be harvested before the slower crop begins to fill in the space

There are two methods of multiplesowing. Intercropping involves sowing two crops in alternate drills, when intersowing, two crops are sown in the same drill. Intercropping can also be employed to combine a tall-growing crop with a trailing or root vegetable, so that the growth of each crop does not compete with the other. For instance you can sow corn with squashes or plant potato tubers with brassica seedlings and cut down the potatoes as the brassicas mature. Intercropping is also ideal for deep beds (see p 283). Peas may be sown down the middle with potatoes or corn on either side, or onions.

### shallots, or brassicas may be sown with leeks, roots, and greens along the sides where the soil is more moist

### SOWING IN CONTAINERS

Sow in a seed tray, small pot (see below left), or pan, depending on how many plants will be required. Generally, a 37/10 (9cm) pot or a 5-610 (13-15cm) pan is sufficient for most vegetable crops

To prepare the container, fill loosely with seed soil mix (see p.34), tap the container on the bench, and level off any excess with a straight piece of wood or cardboard. Firm the surface with a presser board or an empty pot to within

in (2cm) of the rim. Water if needed then broadcast-sow the seeds or sow singly on the surface. Sieve a little moist soil mix over the seeds and give a final press. Cover with glass or a plastic bag or place in a closed case, ventilating daily to remove excess condensation.

Keep the seedlings in good light once germinated. As soon as the seedlings produce 1-2 seed leaves, they should be transplanted singly (see below, center) to avoid overcrowding and any damage to the seedling roots. Prepare 2-3in (5-8cm) pots or cells, as before, with potting mix. Make a hole in each pot or cell and carefully insert a seedling, firm and water.

### SOWING IN CELL PACKS

Seeds can be sown directly into cells (see below). This eliminates the need for transplanting and allows plants to grow unfundered. It is especially good for plants that are set back by root disturbance. A good-steed cell allows seedlings to develop strong roots, even if conditions are not suitable for planting out at the optimum time. Pelleted steels can be sown one seed per cell, other seeds are sown 2–3 per cell and thinned

### MULTIPLE SOWING TECHNIQUES



INTERCROPPING Thody sow rows of quark sower g vegetables (to re of lettuce) between de lis witte weeds sower at stations of a slower crop (here of broccole). When the se-along charatwo feaves, (to) one to obe w healthy growth

Delt RSOWING Station sow (see facing page) a slow crop such as parsoips. Sow seeds of a faster-motiving crop such as radish (ties) thirdly between stations. Lift the fill in crop with care to avoid disturbing the main crops roots.



### BROADCASI-SOWING IN POTS



I For seeds that germinate erratically or if only a few piants are needed, sow in a Join 9cm) put of seed soil ones, scattering the seeds thinly and evenly. Cover to their own depth if more water and labor



When the seedlings (here cabbages) have two seed leaves, transplant them into cells of soil new Discard much smaller ones and any that show signs of cold dumage of disease Water and label the seedlings.

### SOWING IN CELL PACKS



Fill cell packs with seed soil mix and familightly Make holes about %in (5mm) deep in each cell. Sow several seeds in each noblightly cover with mix, label, then water from the seedlings when they appear to leave the strongest in each cell.

### MULTIBLOCK-SOWING



I fill a cell tray with moist potting my Make a shallow depression in each cell with void longer. Sow 3-4 seeds in each cell and lightly cover with mox. Water, label, then put the tray is a light, warm place.



In this method of sowing (see above) 3–5 seeds are allowed to germinate and grow as a group. The benefit of this method is that many plants may be grown in a small space. It is suitable for root, bulb, and stem vegetables such as onions, turnips, beets, and leeks, rather than leafy crops such as lettuces.

### TRANSPLANTING FROM A SESDBED

Water the seedbed if it is dry, then lift out the seedlings gently with a trowel retaining as much root and soil on them as possible. Never handle the stems lease the seedlings apart and discard any that are diseased, look out for wire stem (a shriveled, brown stem beneath the soil surface), root rots, and clubroot also discard weak, small seedlings.

Plant healthy specimens in moist soil, preferably in the evening, when showers are expected. Make a hole just large enough for the roots, then position the seedling so that its lowest leaves are just above soil level. Planting too high exposes the stalk, which may snap off in the wind, planting too deep can allow diseases to develop. Firm in each seedling so that there are no air pockets around the roots, then water in well.

TRANSPLANTING CONTAINER-SOWN PLANTS
Before transplanting in colder climates
ensure the seedlings are hardened off
well by placing them in a cold frame,
gradually increasing the ventilation over
a period of 7-10 days. Alternatively,
place in a sheltered site outside during
the day for increasingly longer periods

Water seedlings well before lifting them. Each should come out with a good, clean root ball. Some cell packs are reusable, with holes at the base, so use a piece of wood or stake to push out the plugs. Plant out as above and firm in just covering each root ball to prevent it from drying out, and water in well.



2 the seeds should germinate within 5-7 days. Do not than the seedlings. When they have one or two true leaves, plant our seedings in their plugs, at the correct distance for the crop there turneps.



3 Leave the untilinated seedings to develop as clusters of vegetables. Despite being crowded, the planes should produce attractive behy? vegetables

### GROWING VEGETABLES IN CONTAINERS

Most vegetables can grow successfully to containers, either outdoors of protected in a greenhouse. Exceptions are veget obles that need a lot of space, such as squash, larger brassicas, rhubarh, and corn.

Outdoor containers are ideal for those with this gettlens or as a way of avoiding soil borne diseases. In colder chinates, early one ps may be produced under glass, or lants may be started inside and moved outside to grow. It is also possible to extend the season by bringing plants in containers under cover in autumn.

Sunable containers include grow bags at the containers include grow bags and even banging baskets. The containers may be a min main.

10m (25cm) or up to 3ft (90cm) in diameter and up to 2ft (60cm) deep. Make sure that the containers are out of full sun for part of the day in a sheltered site. Do not place them too close together or the plants will produce more leaf than crop

Good distange is vital make distange holes in the base. Use good garden soil with added pear and well rotted manure of compost, and add a sautable fertilizer. Crops may be sown direct, or the seedings may be transplanted into the containers. Once it is parated, mulch each containers with composted bank, well rotted none-compost, or gravel to help retain moisture. Water up to three times daily in hot weather apply a liquid left. Let again a



A GROW BAGS Crops such as tomatoes (as here) agplants, and cucumbers may be raised in grow bags particularly where soil borne diseases are prevalent

► CLIMBING CROPS
Climbing crops such as
runner beans or eucumbers
should be grown in large
containers of soil-based mix
to allow for vigorous root
development



# CULINARY HERBS

Few things may be more deaghtful than going into the garden and picking some fresh herbs for use in the kitchen Culinary herbs generally are short-lived plants, so they must be propagated regularly. In most cases, this is easy to do Cultivars, especially variegated ones do not come true from seeds, while other herbs may not set seeds, especially in colder climates, these herbs may be increased from cuttings, division, or layering, depending on the type of plant material. The only way to grow annual and biennial herbs is from seeds. Most herbs prefer a free-draining soil that is reasonably fertile, but not too rich, in full sun. For details on specific culinary herbs, see the A-Z of Culmary Herbs op 290-91)

### TAKING CUTTINGS

Cuttings may be taken from the first solt shoots at the start of the growing season, when they have the highest rooting potential, or from semi-ripened shoots later in the season, some shoots root best if taken with a heel. Cuttings may also be taken from the creeping roots or rhizomes of certain herbs

### SOFTWOOD CUTTINGS

haking soltwood stem-tip cuttings from the new growth is suitable for many perennial herbs, such as lemon balm mint, oregano, rosemary, sage, and thyme, and this is especially useful if the plant is not large enough to supply root cuttings (see p.288). Taking cuttings often spurs a plant into new growth and helps keep it bushy.

In spring or early summer, prepare some containers (pots, seed trays, or cell packs) with a free-draining rooting medium, such as one of equal parts fine bark and peat. A free-draining mux is essential because the cuttings are at risk of rot before they root.

Collect the cuttings material in small batches in the morning, when they are less likely to become dehydrated (see below). Use a sharp knife, not seissors which tend to pinch and seal the stem and hinder the rooting process. Place the shoots immediately in the shade in a plastic bag or bucket of water, because even a slight loss of moisture will hinder the cuttings' ability to form roots.

Prepare the cuttings as shown below leaving the top leaves to feed the cutting as it roots. Do not tear off the leaves because any damage can admit disease – carefully cut them off with a kinde

Make a hole in the rooting medium for each cutting. Never allow the leaves to touch the medium or be covered with it, because they will rot and may encourage fungal growth that can spread up the stem and to other cuttings. Overcrowding the container also increases the risk of fungal disease.

Do not insert cuttings of different species in the same container because they quite often take different periods of time to root. Dip difficult-to-root cuttings in hormone rooting compound just before inserting them.

Keep the cuttings out of direct sun in hot weather – bright shade is best for the first week. In cool climates, the best place is a greenhouse. Cover the container with a plastic bag (see below)



HIEL CLAUNGS

In spring, select a new shoot there of purple sage) not more than 4m (10cm) long. Grasp it near the base and gently pull it away from the main stem so that it retains a small sliver of back (the "heel"). Trun the heel of the cutting and remove its lower homes as a reserver.

or a cut-off plastic bottle (see p.39). To stop excess moisture from dripping onto the cuttings, turn the plastic bag inside out every few days when condensation builds up. If fungal growth appears on a cutting, pick it out at once

Softwood cuttings of easily rooted herbs, such as lemon balm, marjoram mint, and tarragon, will root in water, as for perennial cuttings (see p 156)

### HEEL CUTTINGS

Take these from short new shoots (see above). The growth hormones that assist the rooting process are concentrated in the "heel" of old wood. When pulling away the shoot, avoid tearing bark from the shoot, since this may expose it to infection. Treat as for softwood cuttings.

### TAKING SOFTWOOD CUTTINGS OF HERBS



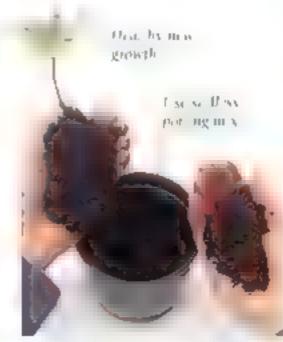
In spring, take 4in (10cm) cuttings (here of golden lemon balm) from healthy nonflowering shoots of the new growth cutting nest above a node. To prevent the leaves from losing moistare, placithe cuttings in water



2 fell a pot with equal parts moist back and peat. From the base of each cutting just below a mode, then strip off all but the top twent three leaves. Insert the cuttings in the mediant so that the leaves are just above the surface



3 Firm in gently and water Allow the pot to drain, then label it fent the pot with a clear plastic bag supported on stones to prevent contact with the leaves. Keep the cuttings in a lightly shaded position about 68 F (20 C)



When well moted (usually after about four weeks), knock out the new plants and gently tease them apart. Try to keep the medium around the mots intact. Pot each cutting individually in a pot sin lem) larger than the root but

#### TAKING ROOT CUTTINGS OF HORSERADISH



I to spring the teachy place to the egg to the two tengths of root 6-12m (15-30cm) long



each cating 1-2 m (2.5-6cm) deep in a prepared cell tray



then final positions. Hald by the leaves and plant at the same depth

## TRIMMING OTHER ROOT CUTTINGS



To distinguish the ends when about the color of the color

### TAKING CUTTINGS OF MINT RHIZOMES



I heat if izomes of heibs sach

as more as not cattings. Lift the
plant and wheet thezomes that have
plenty of growth mate Divide them

may 1 4-3 a - 4-8 or ) sections



2 Make holes in a proportion in the cutt ogs (see tinsel vertically at deover with the soft water).



3 Place the cuttings in a warm bright access to growth starts or a rock terbt zer When they have took descent ever meet here out of the pot and tease apart



A Pot the curings stagly onto a back and peat one Water to obel and leave is a warm by stoplace total well established and ready for plant as acc.

### SEMI-R PE CUTTINGS OF HERBS

herbs such as hyssop or rosemary may be rooted from cuttings taken from new shoots that are semi-ripe, that is, no longer soft but firm and starting to turn brown. Prepare them as for softwood cuttings (see p 287). Tender herbs such as bay root more successfully if provided with bottom heat of 64°F (18°C) and high humidity – a heated closed case is ideal. The cuttings will be in the same medium for longer than softwood cuttings, so use a very free-draining mix of equal parts peat, fine grit or perlite, and fine bark.

Spray the cuttings every morning and afternoon for the first week. Never spray at night, because the lower temperatures may encourage rot or powdery mildew on the wet leaves. Rooting medium is low in nutrients, so give a foliar feed once a week when the cuttings show signs of rooting, usually in 4–8 weeks.

As for all cuttings, do not test for rooting by tugging, because this may disturb the cutting at a crucial time instead, check for new roots showing at the base of the container; alternatively wait for new shoots to appear

In colder el mates, once they are rooted harden off the cuttings. Bring them, in stages over 2-3 weeks, into sunny, airy conditions, then pot singly in soil-based potting mix (see p.34). Label and water well. When the cuttings are growing well, 4-5 weeks later, pinch out the growing tips to make them bush out and become stronger. Allow the new plants to establish and thoroughly root down in the pots before planting out.

#### ROOT CUTTINGS OF HERBS

This method is suitable for herbs with thoughke or creeping roots, such as horseradish or rhizomes, such as mint lake the root cuttings in spring or autumn. First prepare a container with some rooting medium of one part fine bark and one part peat and firm to just below the rim. Water well and allow to drain while preparing the cuttings.

Lift the parent plant and remove some healthy roots. For most herbs including mint (see above), they should be of average thickness. Most cuttings are prepared by dividing the roots into 1/2-3th (4-8cm) sections, each with an angled cut at the base (see box above)

Rhizome cuttings should have at least one growth bud. Insert them vertically with the bud toward the top, 1–2/m (2.5–6cm) apart. Horseradish roots do not have visible buds but root readily whichever way up they are, so they can simply be sliced into small sections (see above). Water the cuttings, then label and date them, this is important with root cuttings, which cannot be identified until they have grown on

keep the cuttings in a bright place at 50°F (10°C) or above such as under the greenhouse bench or on a windowsill but not in direct sunight. Do not water until new roots or topgrowth appears (2–3 weeks), then apply a liquid feed Root cuttings often produce shoots before roots, so check for good root growth before potting the cuttings

In co.der climates slowly harden off the cuttings once they are rooted by putting them outside during the day and into a cold greenhouse at night. Pot them in a soil-based potting mix once they are weared, and water well. Omit this stage if the cuttings were rooted in cell packs. Treat the cuttings thereafter as for semi-ripe cuttings

### DIVISION

Perennial herbs lend themselves to being divided, once the plant is well established. It is a simple method of propagating a few plants at a time. Division restricts the spread of the plant and keeps it healthy and vigorous, thus producing lots of new growth that can be used in the kitchen, it also prevents shrubby herbs from becoming too woody. This technique is good for fennel, French tarragon, lemon balm, lovage mint, oregano, and thyme

Herbs should be divided either after flowering in late summer or in early spring. The best time is when growth is minimal, and in warm, mild weather to avoid cold damage. It is important not to allow the roots to dry out, so the new divisions should be replanted as soon.

as possible. Before dividing the plant therefore, dig over the planting site make sure it is free of weeds, and add a handful of general-purpose fertilizer

When you lift the plant (see below), remove all the roots, because any piece left in the ground may produce another plant. This is particularly important with invasive plants such as horseradish or mint. Wash the roots to make it easier to disentangle them and divide the plant (see below). Small or herbaceous plants may be pulled apart, but larger or

woody clumps will need to be cut into pieces, using a clean, sharp knife or pruners. Make sure that each section has a good root system, and discard any old. woody, or very congested sections

Replant the divisions immediately (see below) Water thoroughly, even in damp weather. Keep the plants weed-free and well watered until established.

#### SEPARATING HERB SUCKERS

Woody herbs such as bay sometimes send out offshoots, or suckers, from the roots. These should be removed in spring, because they will spoil the shape of the plant. If they have roots, the suckers can be potted and grown on

To detach a suckering shoot, scrape back the soil to expose the base of the plant and carefully pull off the long suckering root where it joins the parent plant. Cut back its main root to just below the fibrous, feeding roots. If there are several shoots on the sucker divide the main root so that each shoot has its own roots. Cut back the topgrowth by about half, then pot each sucker in soil-based potting mix, and allow to root in high humidity at 59°F (15°C)

Rooted suckers may be planted outdoors in warm climates. In colder climates, grow on under cover or in a sheltered spot and keep frost-free for the first winter before planting out

### LAYERING

If an herb has flexible shoots growing close to the ground, they can be simple layered. This is a reliable method for bay, sage, thyme, winter savory, and trailing forms of rosemary. It helps to cut back low branches of the parent plant during winter to induce formation of vigorous shoots for layering. Prepare the soil around the plant where the shoots are to be layered during winter or early spring by mixing in peat or compost and fine grit to aid drainage.

Layer young, ripe shoots in summer Fach shoot to be layered is laid in a trench in the prepared soil and pinned down (see p. 290). The trench is then tilled in and firmed well. Keep the soil moist until the stem is well rooted usually this takes 2-3 months and is accompanied by new growth on the shoots. In autumn, uncover the soil between the rooted layer and the parent plant and sever the shoot. Allow the layer to grow on Pinch out the growing up from the layer 3-4 weeks later and lift if the roots are well advanced and showing lots of new growth. Otherwise leave it for another year

Plant out each layer in prepared soil Label, water, and allow to establish in some climates, it will be necessary to protect the young (continued on p.290)

#### DIVISION OF HERBS



I in late summer after flowering, choose a vigorous, mature plant (here thyme) Lift the plant with a garden fork, taking care not to domage the roots



3 If the parent plant has plenty of topgrowth trim it back with princes to about 4in (10cm) to minimize measure toss through the leaves



2 shake off as much loose soil as possible and remove any dead leaves or stems. Wash the roots clean in a backet of water or with a garden hosi



4 Divide the plant into smaller pieces cach with a good root system and strong topgrowth. Cut with clean, sharp pruners or pull apart by hand



5 Before replanting dust any cut surfaces with fungicide Prepare a planting site and replant the divisions at the same depth as before, spacing them sufficiently far apart to allow for growth. Firm, label, and water thoroughly

### SIMPLE LAYERING HERBS



I Select a young, healthy few graving shoot chere of novemory) Strip the leaves from about 22m 20cm of the stem starting 4m (10cm) from the rip



2 Lower the shoot to the ground well mark its position on the soil Dig a trench slopping and from the plant that is 4-fite (10-15cm) deep at the far end



3 have the see pped stem along the base of the trench Scratch the back a little at the point when it bends. Por the stem against the side of the trench with wire staples.



4 Fill the trench with soil, firm in, and label. Water and keep the soil in 1st. The stem should produce roots at the point where to bends (see inset) after 3-4 weeks

(continued from p.289) layers of tender herbs, such as bay, against cold and drying winds with fleece or straw. For this reason, it helps in cold chimates to pot young layers as soon as they have rooted in equal parts peat, fine grit or perlite, and fine back, and overwinter them in a cool greenhouse before planting out in spring

#### MOUND LAYERING HERBS

This technique is best used on specimens of perennial herbs that are past their best, such as rosemary, sage, lavender, and winter savory, and is especially good for thymes, which can become woody

In the spring, mix some soil with equal parts of peat and sand, then pile if over the plant (see below). If any soil is washed away by rain, replace it. By late summer, roots should have formed along many of the stems. The rooted layers can be removed and potted or planted out as for standard layers (see above). Dispose of the old plant.

### MOUND LAYERING



In spring to encourage the stems to root, mound 1–5(n), 8–13cm) of sandy soil over the crown of the plant (here thyme), so that just the tips of the shoots are visible. Keep the mound watered by late summer or autumn, remove the soil and cut off the rooted layers (see inset)

### SOWING SEEDS

seeds of annual and biennial herbs such as angelica, basil, borage, caraway, chervil, cilantro, dill, sweet marjoram and parsley, may be sown in containers under cover or outdoors or in seedbeds depending on the climate. Perennial herbs can be raised from seeds, but vegetative propagation results in mature plants more quickly. Many culinary herbs are species and, if grown apart from other forms, come true from home-gathered seeds.

#### GATHERING SEEDS FROM HERBS

Gather the seeds for sowing as soon as they ripen in the summer or autumn Bear in mind that certain herbs may cross-pollinate. When different cultivars of lavender, marjoram, mint, and thyme are grown near each other, the chances of the plants naturally hybridizing are high, and the seedlings will vary in appearance and flavor. Closely related species may also interbreed if they flower at the same time, dill and fennel are known to cross, resulting in an herb with an indeterminate flavor.

Seeds should be gathered as soon as the color of the seed pod changes. The seeds ripen very fast, usually to a pale brown color, so watch them carefully to test if a seedpod is ripe, tap it gently If a few seeds scatter, it is time to gather them. Cut off the seedheads on their stalks and dry them to extract the seeds.

The the stalks in small bundles, keep them loose so that air can circulate between them. Hang the bunches to dry thoroughly for up to two weeks in a warm, but airy, dark place; do not use an artificial source of heat — it may kill some seeds. Place a large piece of paper or a sheet under the seedheads to gather the seeds as they fall (see facing page). Alternatively, the seedheads may be enclosed in paper bags (not plastic ones which will make the seedheads "sweat").

or in musiin (see facing page) before hanging them up. Store dry seeds as for vegetable seeds (see p.282)

#### SOWING HERB SEEDS

Sow herb seeds as for vegetable seeds (see pp 282-6). Most herbs germinate at about 55°F (13°C). In colder regions sow tender herbs, such as basil and cilantro, in containers under cover in early spring or outdoors in late spring.

#### A-Z OF CULINARY HERBS

ANOTE ICA ANOTE ICA ARCHANCELICA (SVI)

4. officinalis) Seeds viable for three months
sow in autumn outdoors of they germinate
and the back in winter, they will region
in spring 1

Nost Hyssor Agastacins for accretical (syn A amouta) Softwood cuttings in summer H Divide in spring J. Seeds in spring or autume H

BASID OCAMENT RASILICEM Sow seeds und a cover at 64°F (18°C) in late spring or outdoors at 59°E (15°C) in early summer seedings taprooted and prone to damping iff needs warm, sheatered site ! BAY LAURE 5 NOBBLES Seria ripe currings in late. summer or early autumn, root in high humidity 111. Divide suckers in spring 111 Simple layer in spring 111. Surface-sow seeds in autumn under cover with bottom heat of 64°F (18°C): keep just moist, germination. can take 10-20 days or 6-12 months 111 B' F BALM B REAMOT MONARDA DIDYMA Softwood cuttings in early summer 11. Roo. cuttings in spring [4]. Divide in early spring \$\square\$\ Seeds with bottom hear of 64°F (18°C). in spring or outdoors after frosts III. BORAGE BORAGE OFFICINALIS Sow seeds outdoors in early to late spring, 2m (5cm) deep taprooted [

CARAWAY CAREM CARVI. Sow seeds in early autumn in cells or pots; for root crop, sow in drafts and thin to 8in (20cm), bolts if transplanted late, dishkes root disturbance \$. CHERVE, ANTHRISCUS CEREFOLA M. Sow seeds

If the seeds are very fine (such as oregano seeds), use a piece of cardboard folded in half. Put a small amount of seeds in the fold and gently tap the cardboard to sow evenly. When sowing dark seeds outdoors, pour a little sand into the bottom of the drill (see p 283) before sowing. This makes it easy to see the seeds and avoids sowing too thickly

Herbs from the carrot family, such as caraway, chervil, dill, or parsley, as well as basil and borage, have long taproots, transplanting sets them back. Sow the seeds direct outdoors or singly in pois or cells to avoid disturbing them.

Seeds of most herbs germinate in a few weeks. With herbs that are slow to germinate, such as bay, chives, fennel parstey and sage, provide bottom heat of 64°F (18°C) in cool climates. Otherwise, sow outdoors when the soil temperature is above 50°F (10°C), and all risk of frost is passed. Keep the soil moist.

Some herb seedlings, for example basil, oregano, and thyme, are prone to damping off (see p.46). Keep the soil mix just moist, watering from the bottom and never at night

Seeds of herbs used in quantity, such as basil or parsley, are best sown in successive batches every 3-4 weeks





SELE-SOWN SEEDLINGS
More harbs (here Chinese chives) self saw in
the mabble conditions. Lift them when they or
large chough to bandle, then transplant

#### GATIORING SEEDS

superior, seedheads are best hang on their stalks upside down in a warr), dry, atry place. Lay paper on the floor belove or enclose the seedbeads in cloth to catch the seeds as they fall.

at 50°F (10°C) in early to late spring. taprooted (see above) 4. Prefers semt shade CHECA THE MACHOPROPRIATE DIVIDE BUILD clamps in spring or autumn (see p 254), plant in clamps of 6-10, 6in (15cm) apari 4. Sow 13-15 seeds per 1 mn (3cm) cell in spring with bottom heat of 64°F (18°C) 4 CIT ANTRO CORGANOR AT SATISFAL Sow seeds in early or late spring, disakes excess moisture or humidity, thin to 2in (5cm) apart for leaf crop (calantro) or 9in (23cm) apart for seed crop 11. Try Muroeco for a seed crop DIL AND DIEMERATORENS SOW seeds in early spring or outdoors in late spring, shallowly in poor soil, thin to fin (20cm), seeds viable for .hree years, taprooted 1. FENSEL FOENR DIL M VPLGARE DIVIGE every 2-3 years in autumn 4. Sow seeds in early spring in pois of ceils. cover with perlite bottom heat of

outdoors in late spring and thin
to 20th (50cm) |
Horsegatish Armiracia
Restrand (syn. Cochlearia
annoracia) Root cuttings in early
spring | Devide clumps in spring
or autumn | Can be invasive
Hyssophy of all exams Soft
wood or heel cuttings in late spring or after

59-70°F (15-21°C) helps sow

wood or heel cuttings in late spring or alter flowering 14. Sow seeds in spring with bottom heat of 64°F (18°C) or outdoors after frosts 1. JUNIPER JUNIPER IN COMMUNIS. Take softwood cuttings in spring or semi-ripe heel cuttings.

in summer or autumn 11. Sow seeds audoors in spring or auturent getir nates in four weeks or in a year 114.

Levies harst Meassa oracesares. Lace softwood cuttings in lace spring or early surface II. Divide in spring or autumn I seeds in spring with numinium watering I lesson streams and area spring or semi-ripe cuttings in summer II.

LONGE LEVISTICEM OFFICINALE. Davide in autumn or spring 4. Sow seeds outdoors in autumn or in spring under cover with bottom heat of 59°F (15°C) 4. Space 2ft (60cm) apart Mixes Mixes Stream Stream Take softwood cuttings in summer 44. Take rhizome cuttings in spring 4. Divide in spring 4. Invasive

MYRITE MORTES COMMENTS. Take softwood and rings in late spring or senti-ripe and rings in a pariet 44

Unicano. M (morant Oricans at ve toaks
Take softwood cuttings in
summer 11. Divide in spring or
after flowering 1. Surface-sow
seeds in spring thinly
germination often erratic 1

Sow annual seeds in early spring with bottom heat of 64°F (18°C), or in late spring lin (2.5cm)

deep in rich soil at 59°F (15°C) keep moist, germination is slow 1

BORAGO OFFICINALIS

ROSEMARY ROSMARINES OFFICINALIS Senti-ripe mangs in we so macr 44. Heel cuttings in spring 4. Sample or mound layer in summer 4. Saot. Salvia of the treates. Take heel or but (15cm) softwood cuttings in spring 4. Sample aver in summer after flowering 1 Memor drift top of heart feel species may carly spring, covered with peritte bottom heat of 59°E (15°C) is useful [ SORBIT ROMEN ACETONA. Divide in autonom & Seeds in spring or outdoors in the same 1 SWELL CICLLY M. RRIES OPORATA. Take root. cuttings in spring or autumn L. Divide in autuntif 4. Sow seeds outdoors in autum 1 or winter, slow to germinate 11 SWEET MARJORAM ORGANEM MAJORANA Softwood cuttings and division, as for marjoram, in warm climates. In colderclimates, sow as annual in spring | TARRAGON ARTEMISIA DRACT NOCTO'S Softwood cuttings in summer 11. Take cuttings from underground runners in spring after frosts 1 Divide mature plants every 2-3 years in spring | French tarragon rarely produces ripe seeds in cold climates, but Russian tarragon (subsp. dracunculoides) seeds freely 1 DISSMIN THOMAS SPECIES, Take 2-3in (5-8cm). softwood cuttings in late spring or summer & Take 2m (5cm) heel cuttings in late spring ## Simple layer in early autumn or mound layer. in spring & Surface sow seeds of T vulgaris only, in spring with bottom heat of 68°l. (20°C) or outdoors in late spring or early summer at 59°F (15°C) [

# A-Z OF VEGETABLES

#### INDEX TO MAIN ENTRIES

ASPARAGOS see Asparagus BEAN see Phaseolus BEAN SPRULTS see Vigna Black see Beta Вок счог see Brassica SROAD BLASS see Vicia BRIGHT CAR see Brassica SHEASERS SPROKETS see Brassma AL THR BLAN see Phaseolys CARRAGA see Brassina CARDON sed Cynara ( AHRL see Dancus CAL FLOW YO see Brassica. E [1] (Fe s tuberan ( ii) 199 je vid the Jill COS REST Mr. Branch a CHINESE AR BURGE Ser & Julys S. J. Ellis see Apisim see Aprum C.E. pto COLOYAN see Colocasia ( iii see Zea F |4 "> see Lepidium \$ 5-14 here's debilling 1 36/13 ANT SEE NO ASSESSED. 79 No. 4 to PEA To WA BLAN to but I JUREAU P. FENSI. sec Location on CiAllina ser Al Butto Citieble N SEE COCKERS Calmidde Aleksa Stroke SEE FREE THE see Chenopodoum COOP & No HESBY TYAC N. J. BI-AN see Labiab IN PEAN see Mesembryanthenum DIRESALEM AREA WAR size Elekanthus B.ALL s branch KJON Y BLAN or there are K II lisans s Brossed 1.H.K. s. M. CHI F 1091 see Linchilea I AMA BEAS see Phones us M ON STEEDINGS. MUNG BEAN see Vigna MOSTARIA SPRINGERS see Brassica. NEW ZEALAND SPINACH - See Tetragonia. Ch. A see Oxalis CHINE. see Abelmoschus CHICK see Allann CHACLE see Attiplex see Pasonaca PARIEN see Pisami see Arachis POPARO vec yournam 13. 14. 4 see Cucurbi v RAMCTHE see Cichor our RADISE see Raphanus KI 140 see Rheum RE NNI-R BEAN see Phaseolus KI FARAGA see Brasska · 11 % see Tragopogon **4** . see A ham. SCORPUSERA MICHAEL BOOK SEARAGE see Crambe \* 1 mm see A frum h in the see Spinacia Manager Harris 18 see Brass ca SQUASH see Cucurbua We blick 8 see Capsicum 5 52 15 5A ser Ipomoca SWISS LHAR see Beta TARC see Colocasia DMAT 3 Mr Lycopetsicon F RNAP see Brassica WATERL RESS see Rottppa WATERMELON. see CHrul us

For other, less common vegetable crops see the sidebar list on p 309

see Mon at

see Cacurbia.

WANTER PURSLAND

ZUCCHIM

### ABELMOSCHUS OKRA

SEEDS in spring 1

Okra (Abelmoschus esculentus), one of the podded vegetables in this tender genus, is an annual Soak bought or home-gathered seeds for 24 hours before sowing to aid germination. In warmer regions, sow seeds thinly in drills 2/1 (60cm) apart when the soil reaches a temperature of 61–64°F (16–18°C). Thin the seedlings to 8in (20cm) apart

in colder areas, sow seeds in pots, germinate under mist (see p.44) with bottom heat of 68°F (20°C) and 70 percent humidity. Plant out under cover, preferably in low-nitrogen soil, in late spring to early summer, 16in (40cm) apart and at the same temperature and humidity. Harvest pods in 8–11 weeks



Sowing OKRA SLI DS IN POTS

Now three seeds to a 3con (9cm) pot. When the
seedlings have their seed leaves, gently pull out
the most leggy or any weak seedlings and teave
the sturdiest one to grow on

### ALLIUM ONIONS, SCALLIONS, SHALLOTS, LEEKS, GARLIC



Fully orders

SEEOS from spring to summer SEES from late winter to spring CLOVES from winter to spring

The vegetable alliums include bulb omons, scallions, shallots, leeks and garlie. Mostly coolseason annuals, they

grow best at 55–75°F (12–24°C); the bulbs need full sun in late summer to early autumn to ripen. They also like a rich soil. Crop rotation is important because they suffer from soil-borne diseases such as white rot and neck rot.

### BULB ONIONS AND SCALLIONS

Bulb omons (Athum cepa) can be raised from seeds, but sets (small, immature bulbs) are often more successful because they are less disease-prone, tolerate poor soil, and may be started before onton maggots are a threat. Some sets are heat-treated to prevent bolting. Plant sets (see below) in loose soil if it is too firm, the roots will push the sets out of the ground.

Onions need a long growing season so they should be sown early. Sow seeds thinly in drills in spring or under cover in seed trays or ceals from late winter to early spring. They can also be sown in

#### PLANTING ONION SETS



I soil conditions allow, make shallow drills 10m (25cm) apart. Push the sets gently into the soil. Space them 4m (10cm) apart, or 2m (5cm) if they are very small mems are required.



2 Draw the son 2 gently over the sets and firm so that the tips are tast visible from off any dead tomage or stem s so that birds do not pull them out there is no need to water them to anless the soil's extremety div

### SOWING ONION SEEDS



Now omen seeds thenly in drills, and thin according to the desired size of the crop: the closer the spacing, the smaller the mature bulb Trene seedlings were thinned to Int (2 5cm). 2m (5cm) and 4m (10cm) intervals

#### ONION SEEDS AND SETS

	BULB ONIONS	SCALLIONS	SHALLOTS	LEEKS	GARLIC
Matriote vs : 139 Sc	South the winter to early spring thate summer to overwinter \$\frac{1}{2}\$ So whate winter to early spring or autumn \$\frac{1}{2}\$ Heat treated sets early or late spring \$\frac{1}{2}\$	Seeds early spring to summer late summer for overwintering \$1.	Seeds, early spring or late summer   Seeds autumn to early spring   Seeds autumn to early spr	Seeds under cover singly or multiblocks mid- to take winter transplant early summer seeds ourdoors early to midspring {	Cloves, singly in cells in automolor spring, transport spring [
SPACENG OF SEEDS OR SEES	Seeds sow thinly thin to desired spacing (see Jacing page). Small sets. 2in (5cm). Large sets. 4in (10cm).	lin 25cm)	Seeds and sets 6m	Muliblack seedlings.  Air 13cm r  Single seedlings 4-6m  O-15cm	7in (18cm,
SPACING OF ROWS	Seeds and seis 1000 (25cm	8-12(n 20-36(m)	Seeds and sets B-12m (20-30cm)	12m (30cm)	7m + .8cm
SOMENCOR PLANTING HERE	Seeds bin (1cm) Sets 1-1 ain (2.5-dem	47) 4 (V	Seeds and sets on Tem	Seeds win clem Seedlings 6-8/n	lin (2 our
TIMP UNTIL HARVEST	Seeds up to 42 weeks Sets 12-18 weeks	2-10 weeks over winter 30-35 weeks	Seeds 42 weeks Sets 16 weeks	16-20 weeks, can be left o stand over winter	16-36 weeks

multiblocks, six seeds to a cell (see p 286) For successive crops, sow every two weeks. Destroy infested plants or dust drills with an insecticide to control onion maggots. To gather seeds, leave a lew vigorous plants to flower in autumn or the following spring

Scallions are cultivars of bulb onions that are harvested as young plants. Sow as for bulb omons, or plant sets and

harvest in a few weeks

SHALLOTS

Shallots (Athum cepa Aggregatum Group) are raised from sets in the same way as bulb onions and suffer from the same pests and diseases. Remove loose skins or leaves before planting the sets to avoid birds pulling them out. If you have healthy stock, save your own sets to store over winter they should be \u00e4m (2cm) in diameter. Seeds may also be available, sow them as for bulb onions

### LEEKS

Leeks (Allium porrum) are biennials grown as annuals, needing a rich, loose soil high in nitrogen and a long growing season. Sow seeds in drills as for bully onions or in cells (see below) at 50-59°[ (10-15°C) For large leeks with wellblanched stems, transplant 8m (20cm) tall seedlings into deep holes (see below). or trenches. Leeks are prone to thrips damage. To gather the seeds, leave a few healthy plants to flower in the spring

#### GARIK

These biennials (Allium sativum) need a long growing season and a period of cold at 32-50°F (0-10°C) They do not like soils that are heavy. very cold, or high in nitrogen. For best results, buy seed cloves suited to your area and start them in cells (see left). Plant temperature-tolerant cultivars m spring

### PLANTING GARLIC CLOVES



PREPARING GARLIC CLOVES Pry apart this bulb onto cloves with your thambs. Clean off loose finites and arseard any claves that show signs of disease, such as rot. Each clove should retain a piece of basal plate (see inset)



PLANTING GARLIC IN CELLS In autumn plant garla cloves singly in cells, Im (2 5cm) deep with basal plates downward. Cover with soil mix keep cold ever waiter. Transplant in spring when they start to spread

### SCALLION SEEDLINGS



Scallions are best sown thinly. If they are sown densely, thin to 1in (2.5cm) apart to grow on and use the thinnings as salad vegetables

### TRANSPLANTING LEEK SEEDLINGS



MULTIBLOCKS Sow seeds in cells, four to a cell. Transplant each clump of seedlings into a seedbed. Space the clumps 9in (23cm) apart, in rows that are 12m (30cm) apart



SINGLE LEEK SEEDLINGS For well blanched leeks, make holes 6-8ar (15-24m) deep and 4-6m 10-15cm) apart and insert a seedling in each one so that the tents are in contact with the soil at the bottom. Water in and allow the soil to fell in naturally

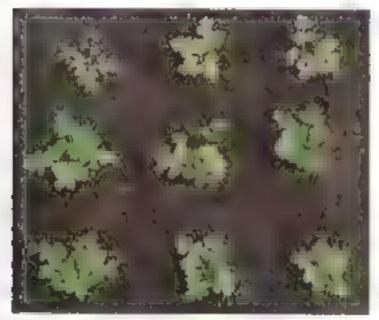
### APIUM CELERY, CELERIAC

Seeds in spring 12 (celery) 111 seele is

Celery (Apium graveolens) and celeriac (Apium graveolens var. rapaceum) are both biennial stem vegetables and temperate crops that can survive light frosts. They prefer a deep, rich, moist soil and a growing temperature of 59–70°F (15–21°C)

#### CELERY

The seeds need light and a minimum of 59°C (15°C) to germinate and should be treated with a fungicide to counteract fungal leaf spots. For trench celers prepare a trench 15in (38cm) wide and 12in (30cm) deep and work in manure or compost. In warmer climates, sow shallowly outdoors — trench celery in single rows to facilitate hilling up, or self-blanching types in a block (see below). Celery seeds may also be fluid-sown (see p.284). Thin out seedlings with 4–6 true leaves to 15in (38cm).



SELE-BLANCHING CELERY SEEDLINGS

Plant out celery seedlings in a rich soil in late
spring or early summer. Plant self-bianching
celery in blocks 9in (23cm) square to encourage
to e stems to blanch naturally.



CELERIAC SEEDLINGS IN A CELL PACK

Now celetiac in seed travs or cells at a monomini
temperature of 59% (15%). Thin to one seedling
per cell and haiden off. Transplant when the
seedlings are 3—4m (8–40 cm) tall and have sex

apart for trench celery or 9in (23cm) apart for self-blanching. In colder regions sow indoors, under mist (see p.44) is best. Do not sow too early, seedlings may bolt if the temperature falls below 50°F (10°C). If sown in trays, transplant the seedlings when each has one true leaf into to 2–3in (5–8cm) cells. Once they have 4–6 true leaves they may be transplanted outdoors if all risk of frost is past, in late spring or early summer. Protect with fleece if necessary

#### CELERIAG

Celerate has a bulblike swollen stem and requires the same conditions as celery but can survive 14°F (-10°C) if protected by straw. It needs a six-month growing season for the stem to develop Sow the seeds in cells (see above) or in trays as for celery. When they are 3m (8cm) tall, harden off (see p 286) the seedlings and transplant outdoors. Space them 12–15m (30–38cm) apart and take care not to bury the crowns

# ARACHIS PEANUT

Seeos in early spring III

Peanuts are tender tropical annuals that require a growing temperature of 68–86°F (20–30°C) with 80 percent humidity, and a sandy, free-draining soil low in nitrogen. Fertilized flowers produce shoots that penetrate the soil the fruits then develop into peanuts Rain or watering during flowering will impede the pollination process and reduce the crop

In warmer areas, sow seeds singly outdoors 2in (5cm) deep, in drills (see p.283) 3ft (90cm) apart, with a minimum soil temperature of 61°F (16°C) Alternatively, station-sow (see p.284) 6in (15cm) apart. Thin seedlings to 12in (30cm)

In colder climates, sow indoors in 36m (9cm) pots or in cells to germinate at 68°F (20°C). Leave the containers in a sunny spot and cover with a plastic bag or place in a closed case to maintain the humidity. Transplant the seedlings into a greenhouse bed when the seedlings are 4–6m (10–15cm) tall, spacing as for outdoors. Begin hilling up when

(15cm) to obtain a crop in 16-24 weeks

GATHERING PEANLTS

Harvest the pods 16-20

weeks after sawing for aprophitypes and 3-4 weeks later for prostrontypes. Allow the seeds to dry in the pods
then shell them and store in a dry place

### **ASPARAGUS**



Aspanagas spears

Seeds in spring \( \)
Division in a counter or early spring \( \)

Asparagus (Asparagus officinalis) is perennial, with separate male and female plants. It may be divided but male, F1 hybrid seeds produce

very robust plants. Asparagus grows best at 61~75°F (16–24°C) and needs cold winters to induce a dormant period for the plant to crop well in spring. The soil should be low in nitrogen, weed-free, free-draining, and not in a frost pocket if necessary, grow asparagus in a raised bed (see p 283) to improve drainage, and add lime to acidic soils

#### SEEDS

Sow seeds lin (2 5cm) deep and 3in (8cm) apart in rows 12in (30cm) apart (see p 283). Transplant the largest as for crowns (see below) to their permanent positions in the following spring Alternatively, sow in ceils in early spring

### DIVISION OF AN ASPARAGUS



In late winter or early spring, when the bads are just developing and before the new root growth begins in carnest, carefully aft the crown with a fork. Shake off any excess sou



3 To prevent rot from setting in, cut away any damaged, diseased, or old growth from each section with a sharp knife. Take great care not to damage or cut into the hids. Dig a trench 12 in (30cm) wide and 8 in (20cm) deep

at 55-61°F (13-16°C), transplant as for crowns (see below) in early summer Allow plants to build up vigor, then begin to harvest after two years

#### DIVISION

Asparagus beds last 20 years if left undisturbed. When lifted crowns will suffer a check in growth and cropping but, if needed, crowns of three years or more may be divided (see below). With mature plants, take divisions from the edges in early spring before new growth appears, and discard the woody center.

With all division, take care not to damage the fleshy roots, and never allow the crowns to dry out. Always replant divided crowns in a new site to avoid soil-borne diseases such as root rot. Placing the crowns on a ridge of soil provides extra drainage, helps prevent rot, and ensures better contact with the soil. Mulch after replanting to retain moisture. In warmer climates, cover the bud tips with 2 in (5cm) of loose soil to prevent drying out. Divided crowns should provide a crop in two years.

#### CROWN



2 Pry apart the crown with your thumbs into sections, each with at least one good had 4 necessary, cut through the crown with a sharp hinge before gently teasing apart the roots



4 Work in 3in (8cm) well routed mannie and top with 2in (5cm) of soil. Make a 4in (10cm) high ridge along the center of the trench Space the crowns on it, 12in (30cm) apart. Cover with soil so that only the bua tips are visible

### ATRIPLEX ORACH, MOUNTAIN SPINACH

SEEDS from early spring to late summer \$1

Orach (Atriplex hortensis) is a fastgrowing leafy annual that self-sows freely. A deep, rich, moisture-retentive soil gives best results. Orach grows best at a temperature of 61–64°F (16–18°C). It bolts and self-sows in hot weather.

#### SEEDS

Fertile seeds are enclosed in papery bracts, those without bracts are infertile Cut off seeded stalks for drying (see p.282). Orach does not transplant well so is best sown direct outdoors from early spring. Make successive sowings every 2–3 weeks during the growing season for a continuous crop. Sow seeds thinly in drills (see p 283). If (60cm) apart. Thin the seedlings to 15 in (38cm) apart. Orach is attacked by slugs and shails; control them (see p 47) when the seedlings are small and vulnerable. Water copiously in summer, especially in dry conditions. Harvest the young leaves at an seven wreas.

### BETA BEET, CHARD

SEEDS in spring !

This small group of vegetables, derived from Beta vinguris includes the halv vegetables known variously as Swiss chard, seakale beet, spinach beet, and silver beet, and beets (Beta vinguris) subsp. vidgaris), grown for their swollen roots. They are all biennials, but beets are grown as annuals.

#### LEAF BEETS AND CHARD

Chard is a "cut and come again" leafy vegetable that comes in white-, yellow-and red-stemmed cultivars. It is hardy to 7°F (-14°C) and grows best at 61–64°l (16–18°C). It is bolt-resistant in the first year if sown after midspring and will withstand hot weather if it is well watered.

Sow the seeds in midspring in drills (see p. 283). 15 in (38cm) apart. Thin the seedlings to 6 in (15cm) or up to 12 in (30cm) if larger plants are required. Sow in early autumn for an early spring crop, these crops tend to go to seed in mid- to late spring, depending on the temperature, the cooler it is the slower they are to bolt.

### BEETS

Beets grow best in cool, even temperatures, ideally around 16°( (61°F) Most cultivars have multigerm seeds (see right). There are also some monogerm cultivars, which have single seeds.

Sow the seeds outdoors when the soil temperature is at least 45°F (7°C) after washing them (see right). Space the drills 12in (30cm) apart, and thin the seedlings to 3—4in (7—10cm) apart. For earlier crops in colder climates, sow in early spring under clockes or in the greenhouse in cells (see p 285), and plant out the seedlings when they are 2in (5cm) tall. For a continuous crop sow seeds at three-week intervals until midsummer. Beets should be ready to harvest in 7—13 weeks.



CHARD

The leaf and stem color varies greatly with the disearcher. Rhubarb Chard F. Chards and other leaf beets can serve a doubte purpose as vegetables and also as an ornamental see grown in a border.

#### BUFF SLEDS

Beet seeds are assorts multigerm each is really a cluster of seeds and produces a champ of seedlings. Thin each to one seeding for a regular crop or leave withinged to form baby beets, as for multiblock sowing



PREPARING BLIT SEEDS

To encourage rapid germination, place the undrigerm beet seeds in a sieve and rinse them thoroughly under cold running water below sowing. This removes the chemicals that inhibit germination. Sow the seeds immediately

### BRASSICA CABBAGE FAMILY



Purple-headed

SEEDS | tru.abaga ||

The brassica family includes a wide range of biennial vegetables, some are grown as annuals or biennials for the shoots or flowerheads, others as annuals for the leaves

and roots. Most are cool-season crops of varying hardiness, with many cultivars for different seasons. They perform badly and usually bolt quickly when temperatures exceed 77°F (25°C) In mild zones they can be grown almost all year, but in hot climates only during cooler weather. Stored seeds remain viable for several years but need to be grown in isolation to come true.

Leafy brassicas prefer a firm soil and need high levels of introgen, but freshly manured soil causes lush, disease-prone growth. Crop rotation (see p. 282) is vital to avoid a buildup of clubroot. If this is a problem, lime the soil and sow seeds in cells to give the plants a healthy start. Leafy brassicas may be sown with root crops or catch crops such as annual herbs or lettuces (see p. 285).

#### BRUSSELS SPROUTS

Cultivars (Brassica oleracea Gemmilera Group) are sown from early to late spring, depending on whether they mature in late autumn, midwinter, or early spring, or in summer in warmer climates. Early types are less hardy, but late crops survive 14°F (-10°C) Sow in cells (see p.285) or a seedbed (see p.283), under cover for earliest sowings. Transplant dwarf cultivars 18in (45cm), and tall ones 2ft (60cm), apart in early summer Keep new plants moist until established and control downy mildew (see p.47). Harvest in 20 weeks.

### CABBAGE

Cabbages (Brassica oleracea Capitata Group) prefer 59–68°F (15–20°C), but the hardrest withstand 14°F (-10°C) for a short time. It is vital to sow cultivars at the correct time for the expected crop (see chart below). Sow in cells (see p.283) or a seedbed or direct (see p.283) if conditions permit. Transplant when seedlings are 2–3 in (5–8cm) tall at the appropriate spacings (see chart below). Use treated seeds to protect against clubroot or flea beetle. Protect seedlings from cabbage root maggot, if needed, with collars (see facing page). Keep young plants watered during dry spells and spray if necessary.

#### BROCCOLL

This (Brassica oleracea Italica Group) is a cool-season crop and prefers an average temperature below 59°F (15°C), but cold may damage buds and young flowerheads. It does not transplant well sow 2–3 seeds at stations (see p 284) or in cells (see p.285) and transplant deeply Spacing depends on the size of head required (see chart, facing page), closer spacing produces smaller heads

#### CAULIFLOWER

Success with cauliflowers (Brassica oleracea Botrytis Group) depends on sowing at the correct time and avoiding checks in growth, such as from dry soil or transplanting. It is vital to choose the

PLANTING DEPTH

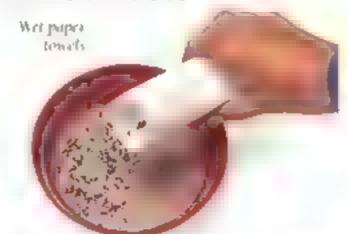
Plant brassica seedlings
to cover most of the
stalk so that the towest
leaves are just above
the soil. The mattac
plant may otherwise
need staking, since the
topge with could be too
heavy for a leggy staln
to support

correct cultivar for the cropping season (see chart, facing page) in warmer regions, sow main crops from midsummer to autumn. Seeds germinate best at 70°F (21°C) Sow direct in spring or early summer for baby vegetables, in rows 9in (23cm) apart and thin to 4in (10cm) apart. Control downy mildew (see p 47), especially on early sowings

#### CHINESE CABBAGE

If sown in spring, Chinese cabbage (Brassica rapa var pekinensis) is likely to bolt unless kept at 68–77°F (20–25°C) for the first three weeks. Most cultivars withstand only light frosts. It is safer to delay sowing until early summer in colder climates. Sow in rows (see p 283) 18in (45cm) apart and thin plants to 12in (30cm). Chinese cabbage is very prone to clubroot. Harvest after 8–10 weeks.

#### SOWING SPROUTS



I me a soucer about 5in (13cm) in diame of with paper towels. Add water to souk the paper, then drain off any excess. Scatter the seeds thickly over the paper. Label and leave in a 10-1 bright place of a maximum temperature o, 59% (15%) to germinate. Cover loosely with a clear plastic bag to retain moisture.



2 The seeds should root into the paper. Check doubt to ensure that the paper is moist and water as necessary gently pouring water against the side of the saacer to avoid distinbing the seeding roots. Allow to absorb, then pour off any excess after one hour. The seedings should be ready to harvest in 7-10 days (see above).

### SOWING CABBAGE SEEDS

WHEN HARVESTED	SPRING	EARLY SUMMER	SUMMER	AUTUMN	WINTER (FOR STORAGE)	WINTER (TO USE FRESH)
TYPE OF CABBAGE	Small pointed or round heads or loose, leafy greens	targe mainly round, heads	Large round heads	Large, round heads (includes red cabbage)	Smooth, white- leaved heads	Blue-green and Savoy
WHEN TO SOW	Late summer to early autumn	Late winter to early spring	Early to mid- spring	Late spring to early summer	Spring 4	Late spring to early summer
SPACING OF PLANTS	Olm + 2 selm	5 r >8cm>	one (38cm	15m 58km	28CF 45CH3	8m («Ser
SPA 150 II RUWS	124 3000	op. (Sep)	, 5 pp. 385 pp.	lara Bacan	18 p 45 gr	asir official

#### SOWING SEEDS OF CAULIFLOWER AND BROCCOLI

	WINTER	Broccou	SPROUTING			
	FRUST-FROE SRI SS	W STER	Extensional	SUMMER & AUTOMS		BROCCOLL
WHEN AND WHERE YO SON	Late spring in seedbed [	Far y summer in seedhed ‡	Autumn in cold traine { Midwinter in warm green- house {	Early cultivars spring under cover   Others: late spring in seedbed	Actumn or spring or aman or cells or at stations   Protect from frost di needed	Spring in cells or secubed 1
W4 8 IC BOSSPIAS	M dsum ner	A Istimmer	Shas a pg	91 2 Million	ar v patring	midsammer
Spa Day it P. 6515	2×r een	24ic occur	2411-000-0	HIT PURE	La Kin N. 45cho.	24) i streir
NPS and of Robbs	spot n	war tear	180 r 4 mm	1803-4508	no Fr. Lie William	1.17 69(19
DME LINTIL HARVEST	40 weeks	40 weeks	16- 33 weeks	16 weeks	11-14 weeks	50 weeks

#### MUSTARD AND SPROUTS

Sow mustard sprouts (Brassica hirta and B. napus) on paper towels (facing page) or in seed trays under cover at any time for salad crop. From spring to early autumn, sow mustard in wide drills or broadcast (pp.283-4) for a seed crop

### KALE, CURLY KALE, BORECOLL

Some kales (Brassica oleracea Acephala Group) survive 5°F (-15°C). Sow summer-cropping kales in early spring, and autumn or winter crops in late spring. Purple kale is best for late sowings. Sow in cells (see p 285) or a seedbed (p 283). Transplant seedlings 12–30in (30–75cm) apart in 18–30in (45–75cm) rows, depending on the cultivar. Sow dwarf cultivars. 12–16in (30–40cm), in containers (see p 286). Multiblock sow for "baby" kales (p 286).

#### KOHI RABI

A cool-season crop, kohirabi (Brassica pleracea Gongylodes Group) grows best

at 64–77°F (18–25°C). Young plants bolt below 50°F (10°C). In milder chimates sow from spring to late summer; in hotter climates, sow in spring and autumn. Purple types are best for late sowings. Sow direct in rows (see p 283) 12in (30cm) apart, thinning seedlings to 10in (25cm) apart. In colder climates, sow under cover in spring in gentle heat and transplant seedlings when they are 2in (5cm) tall and protect with cloches or fleece (see p 39) if necessary. For baby vegetables, sow in multiblocks (p.286)

#### Вок сног

in spring to autumn, sow bok choi
(Brassica rapa var. chinensis) direct six
p 283) or in cells (see p.285), to
germinate at 59–68°F (15–20°C) Mosi
cultivars tolerate cold down to 23°I
(-5°C). Thin the seedlings to 4–18in
(10–45cm) apart, depending on the
cultivar Choose bolt-resistant cultivars
for spring sowings and cold-resistant
ones for later sowings

### BABY TURNIPS

harvested young
Sow the seeds in
multiblocks for large
numbers of small
tamps (here white
tamps) Harvest when the
toots are the segret to got
ball, after meanings every three
works in the growing season

### SPROUTING BROCCOLL

With a long growing season, sprouting broccoli (Brassica aleracea Italica Group) needs a fertile soil. Sow seeds in spring (see chart above) to harvest in the following spring. In milder climates, sow in late summer to autumn or winier Transplant 3—4in (7–18cm) seedlings deep for stability (see facing page) and stake on exposed sites. Purple cultivars are more prolific and hardier, down to 10°F (-12°C), than green ones

### RUTABAGA

Rutabaga (Brassica napus Napobrassica Group) is the hardiest root crop and prefers light, low-mitrogen soil. Sow seeds outdoors at 50–59°F (10–15°C) from late spring to early summer, in rows 15in (38cm) apart (see p 283), thinning in stages to 9in (23cm) apart. As well as flea beetles (use dressed seeds), cabbage root maggot can be a problem in many areas use collars (see left). Harvest in 26 weeks.

#### TURNIP

A temperate crop growing best at about 68°F (20°C), turnips (Brassica rapa Rapifera Group) tolerate light frosts. Sow seeds under cover in late winter to early spring for early crops, thinning to 4in (10cm) apart, then successively sow until early summer. Sow main crops outdoors in late summer and thin to 6in (15cm) apart. Harvest early autumn

### TRANSPLANTING BRASSICA SEEDLINGS



CONTROLLING WEEDS A good method of controlling weeds around young brassica seedlings is to cover the plot with biodegradable brown paper. Cut slits at the required spacings and plant the seedlings through the slits



COLLARS FOR SEEDLINGS To prevent cabbage tool maggets from laying eggs at the bases of seedlings, cut bin (15cm) squares of carpet paiding. Make a slit into the center of each. Fit each collar so it lies flat at the base of the stem

### CAPSICUM SWEET PEPPERS, CHILL PEPPERS



tweet peppers

SEEDS in spring 44

Sweet, or bell, peppers (Capsicum annuum Grossum Group) and the hotter chili peppers (Longum Group) are annual fruiting vegetables. Being tropical or subtropical,

they require a minimum growing temperature of 70°F (21°C) and 70 percent humidity, but fewer fruits set at temperatures above 86°F (30°C) Chili peppers are more tolerant of heat.

Peppers are self-pollmating but are aided by insect pollinators. If grown in isolation, at a distance of about 500fr (150m) from other types, they should come fairly true from home-gathered seeds. In hybrid seedlings, the hor pepper gene is dominant, so a sweet pepper crossed with a hot pepper results in a seedling that is a little more fiery Dry the ripe peppers to ensure the seeds are ripe before extracting them (see right) Store seeds in a cool, dry place

If growing peppers outdoors, sow seeds in pots in midspring, transplant and plant 18-20m (45-50cm) apart in

### EXTRACTING PEPPER SEEDS



early summer, or when warm enough If growing peppers under cover, sow seeds in containers (see p 285) at 70°F (21°C) in early spring. Transplant the seedlings singly into 24-34in (6-9cm) pots when they have 2-4 leaves. At

To extract seeds (here of chili peppers) I remove shoots with ripe fruits that have no description. Hong in a bright, day place to dev. with trave inclienceally to carch any seeds



2 After 3-5 weeks, the dried peppers will start to shrivel and the seeds will be fully ripe Wear gloves to protect the skin from stinging club pure, do not touch your Jace. Cut opereach pepper lengthwise. Scrape out the seeds

3-4m (6-10cm), plant them 18-20m (45-50cm) apart in a greenhouse bed or in grow bags, or pot into 8in (20cm) pots. Harvest in 12-14 weeks. As they ripen, fruits change to red, yellow, or purple; some are best used green

### CHENOPODIUM GOOD KING HENRY

SEEDS from late spring to carry summer \$ DIVISION in sprang 1

Good King Henry (Chenopodium bonusnenricus) is a perennial leafy vegetable that crops for 12-20 years. It goes to seed quickly so is best grown in part shade to slow it down. Sow in rows 18in. (45cm) apart (see p 283). Thin seedlings

(see p 285) to 12-15in (30-38cm) apart Pick flower shoots as early as possible

To divide mature plants, dig up the roots. Take well-rooted clumps from the outside of the plant, which is usually more vigorous, and discard the old woody crown. Replant the divisions 12in (30cm) apart in 18in (45cm) rows.

### CITRULLUS WATERMELON

SEEDS from (md spring to early summa) 👪

Watermelons (Citrultus lunatus) are tropical annuals that require growing temperatures of 77-86°F (25-30°C) They need fertile, sandy loam enriched with well-rotted manure and a generalpurpose fertilizer

In hotter climates, sow seeds direct. two per station (see p 284) and 3ft (90cm) apart. Thin later to the best seedling at each station. To assist the formation of fruits, transfer pollen from male to female flowers - female flowers have a swelling, the budding fruit, at the base Harvest 11-14 weeks later

In cooler climates, sow two seeds per 2/2-3/m (6-9cm) pot (see p 285), they should germinate at 72-77°F (22-25°C) Select the best seedlings, thin to one perpot, then harden off (see p.286) when 4-6m (10-15cm) tall Transplant into a sunny, sheltered spot after all danger of frost has passed, 3ft (90cm) apart. Plant each seedling on a slight mound and, if necessary, protect with fleece or a cloche (sec p.39) until well established. Remove any covers at flowering time to reduce humidity and encourage pollination

Watermelons do not cross with other cucurbits, seeds should come fairly true if parents are grown 1000ft (400m) from other cultivars. Collect the seeds as for melons (see p.300), they remain viable for up to live years.

### CICHORIUM CHICORY, ENDIVE, RADICCHIO

SEEDS from spring to midwinter 1

This genus includes the leafy vegetables chicory (Cichorium intybus) and endive (C endivid) All are grown as annuals and prefer a fertile, free-draining soil that is low in nitrogen

CHICORY AND BELGIAN ENDIVE

Sow chicory as for lettuce (see p 303) The sowing times depend on the type of chicory - sow Belgian types in spring or early summer for forcing, red types (radicchio) in early to midsummer; and sugar loaf

CURLY ENDIVE Endives with curled leaves are less prone to bolt in not weather than broadleaved escaroles

types in summer Sugar loaf cultivars will tolerate light frosts. Chicory takes 8-10 weeks to mature. Lift mature Belgian endive in autumn for forcing in pots

### ENDIVE

Endive is a cool-season crop, preferring a temperature of 50-68°F (10-20°C). It survives some cold, but hardier types, such as broad-leaved escaroles, will survive 14°F (-10°C). If sown early and exposed to temperatures below 41°F (5°C), endive is liable to bolt. Sow seeds

> early summer onward to harvest in 7-13 weeks Endive is a useful vegetable for intercropping with brassicas (see

as for lettuce (see p 303) from

pp 296-7) and other long-term crops.

### COLOCASIA COCOYAM, TARO

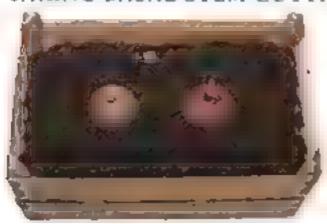
DIVISION in spring 111 CUTTINGS in spring 111

Cocoyams (Colocasia esculenta, syn C. antiquorum) are tropical perenntals with edible tubers that require growing temperatures of 70–81°F (21-27°C) with humidity of over 75 percent. They need a rich, very moist soil with high nitrogen, Seeds are rarely available, so propagation is usually from existing tubers or cuttings. Large tubers may be cut into sections, provided each portion has a healthy dormant bud. In warmer climates, plant tubers or portions of tuber 18in (45cm) apart at 2–3 times their depth, with 3ft (90cm) between rows. In colder areas, root in 8–12in (20–30cm) pots of rooting medium in

greenhouse beds or grow bags under cover; damp down regularly to keep humid. If conditions permit, transplant rooted tubers to a sheltered, sunny site

Afternatively, force tubers into growth in late winter (see below) and take basal stem cuttings from the new shoots. Root the cuttings in the same conditions as for tubers. Harvest in 16–24 weeks

### TAKING BASAL STEM CUTTINGS OF COCOYAM



In late winter two thirds bury healthy tubers in a box of moist peat Keep in a bright place of a minimum of 70°F 21°C) of 75 per tent burn day until shoots appear



2 When shoots are 4-5m (10-12, m) tall cut out each one with a small piece of tiber at the base Plant out 18m (45cm) apart in rows 3/1, 90cm) apart at 70°c 2/2 (2) or orsert in 10m (25cm) pois

### CRAMBE SEAKALE

SEEDS in spring 444 COTTINGS (rott) late autumn to early winter 4

The stem vegetable (Crambe marituma) in this genus is a perennial. It needs a deep and rich, slightly acidic sandy soil. The seeds have corky coats that will inhibit germination, scrape off these coverings with your nails. Sow thinly

in drills (see p 283) or outdoors in seed trays. Seeds germinate at 45–50°f (7–10°C) slowly and unevenly. Transplant 3–4in (8–10cm) tall seedlings

Generally, root cuttings, or "thongs," are more successful (see below). Take them from healthy, three-year-old plants. Lift the parent plant without damaging.

the roots, then clean off the excess soil To avoid inserting cuttings upside down, make a slanting cut at the bottom of each root. Overwinter them in a frost-free place before planting out in early spring. Harvest young stems in the second or third year. For a succession of crops, take cuttings every third year.

### TAKING ROOT CUTTINGS OF SEAKALE



Lesing the assistant the courses of a pener cut at the bottom of each one. Remove these from the rootstock cutting straight across near the top of the root. Discord the old crown





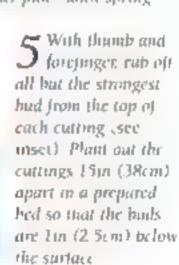
2 Cut the roots into 3-6in (8-15cm) sections entring the top of each one with a straight cut and the base with an angled cut. The the cuttings into bundles of five or six with raffia or twine, matching up straight and angled ends

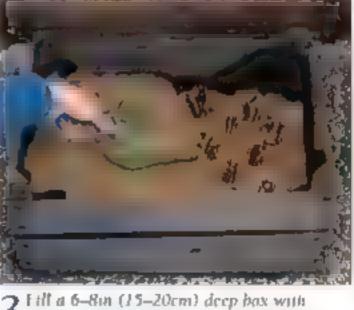
A Carefully lift

The cust ngs when
the buds are just
beginning to break
(see left) in early
spring if they are
allowed to grow in
see large if the
buds will waste
energy that is needed
to produce roots



3 Fill a 6-8in (15-20cm) deep box with 4-5in (10-13cm) of sharp sand, insert the bundles angled ends down and not touching Completely cover with more sand. Water and leave in a frost free, shady place until spring





# CUCUMIS CUCUMBER, MELON

Seeds in spring []

Cucumbers and gherkins (Cucumis sativus) and melons (C. melo) are all tender, annual climbers grown for their fruit crops

#### CUCUMBER AND GHERKIN

These plants grow best at 64–86°F (18–30°C) and are damaged below 50°F (10°C). European or greenhouse cultivars that fruit without pollmation need a nighttime minimum of 68°F (20°C). Soil should be moisture-retentive, free-draining, and high in nitrogen and organic matter. Seeds germinate at 68°F (20°C) and seedlings transplant badly, so direct-sow in warm climates. Sow each seed hin (2cm) deep on a mound to keep the roots warm and well-drained Space climbing types 18th (45cm) apart and bush types 30th (75cm) apart

In colder climates, sow seeds in pots or cells (see above) and plant outdoors when risk of frost has passed, or at the

### SOWING CUCUMBER SEEDS



I Sow socials son for our their sides in 3m (8cm) pots that the trenth seed soil mee Keep at 14 (21 18 21%) In seven days, when each see long has grown above the pot rim, fill in with more mix, then water

same spacings in beds under cover Protect new plants from wind and cold (see pp 38–39). Harvest cucumbers 12 weeks after sowing gherkins are ready when they are 3in (8cm) long.

#### MELON

The various types of melon need a fertile soil with a high organic and nitrogen



2 V few weeks after sowing, dig a hole 12m (30cm) deep and wide and fill with well total manure. Cover with a monad about 6m 15cm) high of manured soil to help dramage plant the seedling on top. Firm, label, and water

content and a growing temperature of about 77°F (25°C). Sow the seeds as for cucumbers, but spaced 3ft (90cm) apart in rows 3–5ft (90cm–1.5m) apart. They usually germinate at 64°F (18°C). In colder climates, sow two seeds per 3in (8cm) pot and thin out the weaker seedling. Harvest in 12–20 weeks. Seeds can be gathered from healthy fruit

### EXTRACTING MELON SEEDS



JUST RIPE

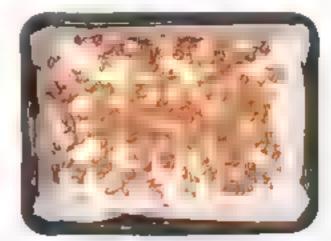


ALMOST ROTTEN

Pick melons when ripe Label and leave them in a cool, dry place until almost rotten to allow the seeds to continue ripening



2 Scoop out the seeds into a viewe and rinse off the pulp under rinning water. If the pulp is left on the seeds, it will inhant geromaic, it



3 Spread out the seeds to dry on paper towels in a warm airy place for 7-10 days. Store in a cool dry place for spring sowing

### CUCURBITA PUMPKIN, SQUASH, ZUCCHINI



Zucelim Rower

Seeds from early to late spring !

Cucurbits are a.l tender, annual, fruiting vegetables. They include summer squashes and zucchini also called courgettes, (Cucurbita pepo), and

winter squashes and pumpkins (C pepo, maxima, C. moschata) They require the same soil as cucumbers (see above), but pumpkins and winter squashes prefer medium to high nitrogen levels

Generally, cucurbits are raised from seeds in the same way as for cucumbers 5ow 2–3 seeds to a 2in (5cm) pot and thin to the sturdiest seedling before transplanting into mounded soil (see above) Or, in late spring, sow 2–3 seeds at stations (see p 284) at the spacings

given in the chart (see right), Sow seeds about 1in (2.5cm) deep Pumpkin seeds germinate more quickly if soaked overnight before sowing. Protect young plants from cold if necessary (see pp 38–39) Mulch after sowing or planting out to keep moist. Cucurbits are good for intercropping (see p 285) with tall crops such as com

Cucurbits will cross-pollmate with others of the same species. To keep the seeds true to type (see right), the the ends of one female and several male flower buds the evening before they open, to prevent insect pollmation. The next day, brush the stamens of the male flowers over the stigma of the female. Seal the female flower until it withers, then label the resulting fruit clearly. The seeds remain viable for 5–10 years.



GATHERING PUMPKIN OR SQUASH SEEDS
Leave ripe pumplings or squashes for at least
three weeks in a sunny, arry place at about 70°t
(21°C) to allow the seeds to mature. When a
fruit starts to soften, cut it in half and flick out
the seeds with a hinfe. If needed, wash off any
flesh, then dry on paper towels by a sessing

### CYNARA CARDOON, GLOBE ARTICHOKE



G obc are choke

SEEOS in early spring \$
scardoon
Division in spring \$ globe
article (sees)

Cardoons (Cynara cardunculus), grown for their stems, and globe artichokes (Cynara scolymus), grown for the

immature flowerheads, are perennials; they need an open site with fertile, moist soil, plenty of well-rotted manure or compost, and a growing temperature of 55–64°F (13–18°C)

#### CARDOON

Cardoons are best raised from seeds Sow seeds singly under cover in pots

#### EXTRACTING CARDOON SEEDS



Hang the prickly flowerheads in a paper bag in a warm, dry place. When they are completely dry, crash them firmly, using a hammer Pack out the plantes that bear the seeds. Store in a cool ary place until spring. Sow with the plantes

(see p.285) in early spring to germinate at 50–59°F (10–15°C). If using homegathered seeds (see below left), do not try to separate the seeds from the plumes before sowing them, just spread them over the soil mix. Transplant the seedlings when 10 in (25cm) tall. Harden off (see p.286) in cold climates. Plant out in late spring 15 in (38cm) apart in 18 in (45cm) wide trenches. Space the rows 4ft (1,2m) apart to allow room to hill up the stems as they grow. Harvest the stems in the following year.

#### GLOBE ARTICHOKE

They are best divided because seeds do not come true to type and seedlings may be difficult to overwinter. There are two ways to divide an established plant

If lettuce root aphid is a problem taking offsets avoids transmitting them take rooted offsets (see right) from the edges of the plant because they are most vigorous, and leave the parent plant undisturbed. Replant the offsets to grow on, even those with hitle or no roots Water them in if conditions are dry. In colder areas, protect offsets with fleece until they are established and with straw mulch, or leaves in the first winter

Established plants may also be lifted and divided like herbaceous perennials. Using a knife, two hand forks, or a spade, split the plant into 3-4 pieces each with at least two strong shoots and some good roots. Discard the old, woods crown. Trim the leaves on the divisions to 5in (13cm) to reduce moisture loss and replant as for offsets in a well-prepared bed. Treat as offsets until established. The first flowerheads may be cut in late summer of the first year.

### GLOBE ARTICHOKE OFFSETS



In spring, select a healthy sideshoot with a leaves and cut it away from the woody crown of the parent plant. Take cute to preserve any roots. To avoid the risk of rot trim off the shift stalks to just above the young leaves.



2 Space the offsets at least 2ft (60cm) apart with 30m (75cm) between rows. If the offset bas few roots (see unset) bury the stem just deep enough to keep it upright. Water and tabel

### **50WING CUCURBITA SEEDS**

GERM NATION - PARTICULAR

Summer squash and zucching 59°F (15°C) Pumpkins and winter squash of "F (20°C)

SEEDL NGS

Bush cultivars. 3ft (90cm apart each way frailing cultivars. 4-6ft (1.2-2m)

Pumpkins and winter squash 6-20ft (2.3m)

A PERMIT RE

64-81°F (18-27°C Pumpkins and winter squash 64-86°F (18-30°C)

I ME JIST MARKIS Summer squash and zucching 7–8 weeks or when about 4m (10cm) long Pumpkins and winter squash 12–20 weeks

### DAUCUS CARROT



SEEDS from spring to late summer |

Carrots (Daucus canda)
are biennial root crops
grown as annuals on
light, fertile, lownitrogen soil. Begin
to sow (see pp 283-5)
when soil temperatures

are above 45°F (7°C), under cover in colder areas. Sow seeds ½-¾in (1-2cm) deep, broadcast or in rows 6in (15cm) apart. Fluid-sow or use primed seeds for more even germination. Thin to 1½-3in (4-8cm), depending on the required size. Round-rooted carrots may be multiblock sown (see p.286). Protect the crop from carrot rust flies with a 3ft (90cm) fine mesh barrier or sow in early summer, after the flies are active. Carrots take 9-12 weeks to mature.



MCTIBLOCK CARROT SLEDLINGS

Plant out clumps of seedlings when they are I'm
(2.5cm) tall. Using a planting board to measure
accurately, plant clumps 9in (23cm) apart. In
staggered rows 9in (23cm) apart.

### FOENICULUM FLORENCE FENNEL



F , rence

SEEDS from spring to late summer II

This annual vegetable (Foeniculum vulgare var dulce) is fairly hardy and withstands light frost. It grows best in a fertile, low-nitrogen, thoist soil at 50-61°F.

(10–16°C). The seeds germinate at about 59°F (15°C). Sow older cultivars after the longest day of the year in

colder climates, otherwise, they will boli f lorence fennel also bolts if checked or left to stand. Station-sow (see p 284) seeds 12in (30cm) apart each way and thin to single seedlings. Sow bolt-resistant cultivars in cells (see p 285) under cover in spring, harden off and plant out in early summer. In warm areas, sow direct in spring for summer crops, and in late summer for autumn crops. On light soils, lightly hill up to avoid wind-rock. Harvest after 15 weeks.

### HELIANTHUS JERUSALEM ARTICHOKE

DIVISION IN ACCURAGE

This perennial tuberous vegetable (Helianthus tuberosus) is very vigorous. It grows best in temperate climates in a range of soils, and it can become invasive if left in place.

Lift a plant in autumn to select healthy tubers. Overwinter them in a box of peat to prevent drying out Divide large tubers (see right) and plant in spring as soon as the soil is workable Choose the site carefully, since the plants can grow to 10ft (3m) tall. Water in very dry conditions

Mature tubers may be lifted 16-20 weeks after planting as required they do not store well and keep best in the soil



Dividing Jerusalem artichoke tubers beed tubers larger than a hens egg may be cut into pieces, each with several bials (see above) Smaller tubers may be planted whole Plant the tubers, bials appearmost, 4-tim (10-15cm) deep in times 12m (30cm) apart. Label and water in

### LABLAB HYACINTH BEAN



Hyacinth bean

SEEDS in spring [].
CLITTNGS in spring [].

The hyacinih bean (Lablab purpureus) is a tender, short-lived tropical perennial, grown as an annual crop in climates with frost. It grows best at

64-86°F (18-30°C) with 70 percent humidity and tolerates most soils

#### SEEDS

In warmer climates, sow the seeds direct in rows (see p.283). Space climbing cultivars 12~18m (30~45cm) apart along rows 30–36m (75–100cm) apart, and dwarf types 12~16m (30~40cm) apart in rows 18–24m (45–60cm) apart. In colder regions, sow seeds under cover (see p.285) in 2–3/m (5–9cm) pots at 68°F (20°C) with 70 percent humidity. When the seedlings are 4–6m (10–15cm) tall, harden off and transplant as above in a sheltered sunny site, or 20–24m (50–60cm) apart in grow bags or a greenhouse bed. Stari harvesting in 9 weeks

#### CUTTINGS

Take 8–10m (20–25cm) softwood stem cuttings and root under mist as for sweet potatoes (see below). Treat rooted cuttings as seedlings (see above).

### IPOMOEA SWEET POTATO

Seeds in spring \$11 TUBERS in spring \$1 CUTTINGS in spring \$

The tropical sweet potato (Ipomoca batatus) is grown as an annual crop and needs a highly fertile, sandy soil with a high nitrogen level and a growing temperature of 75–79°F (24–26°C). In warm climates, it is best grown from tubers or cuttings, in cooler regions, seeds are the best option, but tuber yields are smaller.

### STEDS

Sow seeds in 8–10in (20–25cm) pots to germinate at 75°F (24°C). In warm, humid climates, plant out seedlings when they are 4–6in (10–15cm) tall. In colder areas, grow on under cover at 77–82°F (25–28°C) with 70 percent humidity. Keep well ventilated. Harvest the tubers 20 weeks after sowing.

### TUBERS

Seed tubers must be "cured" before storing overwinter. Lift the tubers in autumn and allow to dry in the sun for 4-7 days at 82-86°F (28-30°C) and in humidity of 85-90 percent. Cover them at night if there is a risk of frost. They

can then be stored in shallow trays at 50-59°F (10-15°C) for several months

in warm, humid climates, plant seed tubers at the start of the rainy season. In colder climates, plant them in spring after frost. Make raised ridges 30in (75cm) apart, then insert tubers 2–3in (5–8cm) deep and 10–12in (25–30cm) apart Protect from winds if needed. Harvest new tubers in 12–20 weeks.

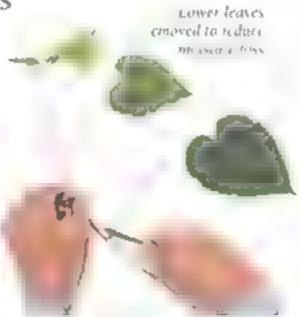
### CUTTINGS ("SLIPS")

Prepare stem cuttings as shown below in warm, humid areas, insert to half their length in ridges as for tubers (see left). In colder areas, root them in pots of soilless rooting medium under cover in the same conditions as for seedlings (see far left). Transplant rooted cuttings into a greenhouse border or grow bags. Harvest tubers in 12–20 weeks.

### TAKING SWEET POTATO STEM CUTTINGS



I Select young, healthy, vigorous shoots on a mature plant and cut them off just above a leaf joint. Place the shoots in a plastic bag to reduce moisture loss. Prepare the cuttings immediately of they will they will not root.



2 Remove lower leaves Tron each shoot below a leaf joint Insert three or four 8-10m (20-25cm) long cuttings to one bin (15cm) pot

### LACTUCA LETTUCE

SEEDS at any time |

Lettuce (Lactuca sativa) requires a growing temperature of 50–68°F (10–20°C) and rich, moisture retentive soil. The seeds do not germinate above 77°F (25°C). Lettuces may be raised from seeds over a long period, but it is vital to choose a cultivar to suit the seasons of sowing and harvesting. Only some cultivars are suitable for warm climates, others tend to bolt at high temperatures in midsummer. Rotate crops every two years to avoid a build-up of fungal disease. Lettuces are good catch crops for intercropping (see p.285).

Sow seeds direct from early spring to early autumn at stations (see p 284) 12in (30cm) apart, or 6in (15cm) apart for small cultivars. Fluid-sow for more even germination (see p 284). Sowing in cells (see p 285) makes best use of space and avoids checks in growth when transplanting. For successive crops, sow a batch every 10–14 days, Transplant into moist soil when seedlings have 5–6 leaves, and shade in hot weather until established. Begin to pick looseleaf lettuces in seven weeks, butterhead cos, and iceberg types in 11–12 weeks.

Hardy cultivars for overwintering outdoors can be sown direct or under clockes in late summer and early autumn to harvest in late spring to early summer; they can also be sown in mid-to late winter in cells under cover and planted out in early spring

### LEPIDIUM CRESS

SEEDS in spring, late summer or in au so i 4

Cress (Lepidium sativum) is a coolseason annual crop that quickly goes to seed in hot weather if not sown in shade at 59–68°F (15–20°C). Sow (see pp 283–4) broadcast or in rows 6in (15cm) apart Cress is good for intercropping (see p 285) and can be sown as for sprouts (see p 296) on paper towels for a crop in ten days



MUSTARD AND CRESS

Sow cress seeds three days before in equal quantity of mixtard (see p 297) weds on moist paper towels. Keep moist until the seedlings are ready to harvest

### LYCOPERSICON TOMATO



Lognato

SEEDS in spring 1 GRAFTING in spring 111

Perennial in the tropics, this tender fruiting vegetable (Lycopersicon esculentum) is grown as an annual crop in colder chimates. They need a rich, moist

soil, sun, and temperatures of 70–75°F (21–24°C). Apart from F1 hybrids, tomatoes come true to type, so it is worth saving seeds. Older cultivars that are prone to diseases such as Verticillium and tomato mosaic may be grafted to increase their resistance.

#### SEEDS

Seeds germinate at around 59°F (15°C) in hot climates, sow outdoors in rows 24in (60cm) apart (see p 283). Thin tall cultivars to 15–18in (38–45cm) apart, bush types to 18–24in (45–60cm). Seeds may also be fluid sown (see p 284). In most areas, sow under cover in cells or

trays of soilless seed mix (see p 285) or rockwool. Transplant seedlings when 3m (8cm) tall, singly into 3/m (9cm) pois. Plant outdoors after frost, when nighttime temperatures remain above 45°F (7°C). Harvest from 7–8 weeks onward.

If saving seeds, allow the fruits to ripen just beyond the eating stage. Cut open and squeeze the pulp and seeds into a bowl. Label and leave undisturbed in a warm place for 2–3 days. A thick skin should form, and the gel that coats the seeds will ferment. After 3–4 days (no longer), scoop the skin off the top and rinse the seeds thoroughly in a sieve under running water. Spread out on paper towels to dry. Seeds can be stored in a cool, dry place for up to four years.

#### GRAFTING.

Use virus-free F1 hybrids as rootstocks for grafting (see below). Stagger sowing seeds of the scion and stock if necessary, so that they germinate at the same time.

### APPROACH GRAFTING TOMATO CULTIVARS





3 Pot the grafted plant in a 4m (10cm) pot in soilless potting mix. Grow on in high humidity at a minimum of 59-64°E (15-18°C) After 2-3 weeks, the graft should callies over Remove the tape carefully



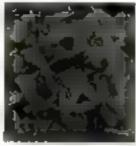
2 but the tongues of the scion and stock plant together. Boid the graft firmly with grafting or transparent adhesive tape, so that the cuts are completely covered. Cut down the stock making an angled cut fust above the lowest leaf



A knock the plant out of its pot Care ally cut through the base of the scion making an angled cut just below the graft umon. Gently pull away the severed roots then replant the grafted plant into its final position

### MESEMBRYANTHEMUM

**ICEPLANT** 



Lepiani

SEEDS in early spring 1

This tender perennial (Mesembryanthemum crystallinum) is grown as an annual it needs sun and light, freedraining soil. In colder areas, sow seeds

indoors in trays or pots (see p 285) and transplant into cells when large enough to handle. Harden off and plant out 12in (30cm) apart in early summer, under cloches if needed. In warm regions, sow direct in rows 12in (30cm) apart, and thin seedlings to the same spacing. Harvest in four weeks.

### OXALIS OCA

TUBERS in spring \$

These plants (Oxalis tuberosa) are tender perennials, growing best in 70 percent humidity at about 68–72°F (20–22°C) In hot climates, plant the seed tubers as for potatoes (see p.307), but 20in (50cm) apart. In colder climates, start the tubers into growth under cover in 8in (20cm) pots in early spring and transplant in late spring when shoots are 6in (15cm) tall. Keep the young plants warm under cloches or plastic film (see p.39). Harvest in 6–8 months, mature tubers will be smaller in colder areas.

### PASTINACA PARSNIP

SEEDS to arly de in late spring [1]

Parsnips (Pastinaca sativa) are a coolseason annual crop and grow best in a deep, light soil. The seeds must be fresh to germinate; pregerminated or primed seeds (see p 282) germinate more evenly beeds germinate very slowly if soil temperature is below 45°F (12°C)

Sow seeds direct in early spring for crops in autumn to early winter, or sow in late spring for overwintering crops. Sowing in late spring avoids the first generation of carrot rust fly and gives tender roots. Sow in autumn and winter also in warm climates. Station-sow (see p. 284) seeds %in (2cm) deep and 4in (10cm) apart, with 12in (30cm) between rows. If broadcast-sown in wide drills thin to 3in (8cm) apart for smaller roots, 4in (10cm) for larger roots.

Parsnips may be intersown with a faster-maturing crop, such as radishes (see facing page). Sow three parsnip seeds at 4in (10cm) intervals and radish seeds between them spaced about 1in (2.5cm) apart. Parsnips should be ready to harvest from 16 weeks after sowing

### PHASEOLUS BEAN



Scarlet runner hear

SEEDS from spring to midsummer |

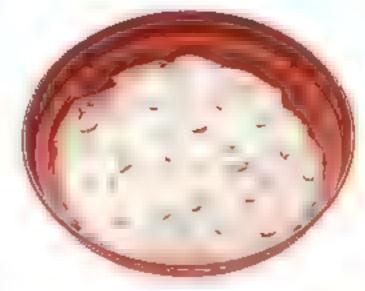
These legumes or podded vegetables include the runner bean (Phaseolus coccineus) the green bean (Phaseolus vulgaris), and the Lima bean

(P lundius). They are all temperateseason, tender crops grown as annuals. Very high temperatures with high humidity prevent the flowers from setting and therefore reduce the crop Legumes are greedy feeders, a few months before sowing, prepare the soil with plenty of well-rotted compost to supply the deep roots. Cold and wet soil can cause seeds to fail to germinate or seedlings to emerge blind. To avoid this, sow in containers (see p 285) or pregerminate seeds (see right)

Beans may be collected for use as seeds (see p.282), except from F1 hybrids, when the pods turn yellow. When dwarf cultivars yellow, uproot an entire plant and hang to dry Discard any shriveled seeds. Seeds last 3-4 years

#### RUNNER BEAN

These beans need 100 frost-free days to mature and a sheltered site to encourage pollinating insects. Sow outdoors under a tepee of row of stakes, two seeds per stake, when the soil is warm enough (see chart, below). For early crops in cold areas, sow singly in cells or pots in midspring and transplant after all risk of frosts has passed.



PREGERMINATING GREEN BEANS

Spread the beans out on moist paper towels
in a saucer and keep damp at a minimum
temperature of 54°F (12°C). Sow the beans as
soon as shoots appear, before they turn green.

GREEN, KIDNEY, OR HARICOT BEAN These are self-pollinating and need a light, rich soil Pregerminate the beans if necessary (see above). Sow climbing cultivars (pole beans) as for runner beans. Sow dwarf types in staggered rows. Successive sowings can be made

up to midsummer (see chart, below)

### LIMA OR BUTTER BEAN

These tropical plants prefer a sandy soil low in nitrogen, In subtropical or warm-temperate areas, grow in the open (see chart, below) in full sun, providing shade until the plants are established in cooler climates, sow in pots as for Lablab (see p.302). Small-seeded cultivars will grow only after the start of summer, when daylight lasts less than 12 hours.

#### **SOWING BEAN SEEDS**

	RUNNER	GREEN, KIDNEY, OR HARICOT BEAN	LIMA OR BUTTER BEAN
WHEN TO SOW	Midspring to early summer §	Midspring to midsummer	Spring 11
GERMANATION/ SOIL	54°F (12°C)	54°F (12°C)	64°E (18°C)
SPACING OF SEEDS OR SEEDLINGS	6in (15cm)	Climbing types 25-4in (6-10cm) Dwarf types 9in (23cm)	Cambing types: 12–18in (30–45cm) Dwarf types: 12–16in (30–40cm)
SPACING OF BOWS	Double rows at 2ft (60cm)	Climbing types double rows at 60cm (24m) Dwarf types single tows at 9in (23cm)	Climbing types: 30–36in (75–100cm) Dwarf types: 18–24in (45–60cm)
SOWING DEPTH	2m (5cm)	1%-2m (4-5cm)	1in (2 5cm
Cornways Temperature	F 84 F (4) 9 V	n Brincari	64 40 1 38 11
TIME UNTIL HARVEST	13-17 weeks	7-13 weeks	12-16 weeks

### PISUM PEA, SNOW PEA, SUGAR PEA



10.0

Seeos to an spring to early surmier or in autumn 11.

Peas (Pisum sativum are cool-season annual crops. They grow best at 55–64°F (13–18°C) in moisture-retentive free-draining soil but suffer excessively in

cord, wet, or dry soil. Dress the soil with potassium sulfate before sowing, and rotate the crops (see p. 282).

Seeds need a soil temperature of 50°l (10°C) to germinate but stay dormant in high summer temperatures. Sow in succession every ten days, or sow more than one cultivar for staggered crops. Wrinkled seeds are hardiest so are best for autumn sowing. Before sowing, soak sceds overnight to aid germination. Sow two rows of seeds 2in (5cm) deep in a wide drill or broadcast in single drills (\$\pi\$ 283). Sow snow or sugar peas also in deep beds, \$2-3in (5-8cm) apari.

To protect seeds from mice, sow in guttering (see right), guard seeds against birds with netting (see p 45)

Peas may be harvested after 10-12 weeks. Seeds come true to type so are worth saving (see p.282). Choose strong plants and allow the pods to mature. The seeds are ripe when the peas rattle in the pod. They remain viable for three years.

### SOWING PEA SEEDS IN GUTTERING



I lake a length of plastic guttering that is 39-6µ (1.1-2m) long. Fill with soilless seed one up to an (1cm) from the rice bow peases is in a double row above 2m (5cm) apart. Water them to settle the soil one.



2 Cover the seeds up to the run with more soil mix. Water again to settle the mix. Label Leave in a sheltered place such as on a sionly windows. If to germinate. The temperature should a showe 50% 100%



3 when the seedings are 3-4m. 8-10cm? tall and their roots are well developed, they can be transplanted. Draw out a shollow trench to the same depth and length as the guttering, then geothy push sections of the seedings, no more that is not the trench. I can in

### RAPHANUS RADISH

SEEDS to spring to late summer 44

Annual and biennial radishes (Raphanus satives) are annual root crops. They prefer a light, rich soil with low nitrogen levels and should be rotated regularly Large winter cultivars such as 'Black Spanish Winter' and the Oriental radishes tolerate cold Each type is sown differently (see chart, below)



Desting Radish seedlings

Dust seedlings with an insecticide at the two-lear

stage to protect against flea beetie, or fertilize to

keep foliage vigorous

Seeds of small radishes are usually sown direct, in batches, at ten-day intervals Broadcast-sow (see p 284) very thinly or sow in drills (see p 283). Small, round types may be used for intersowing (see p 285) with long-term crops such as parsnips. Most large winter or Oriental types bolt if sown before midsummer in colder climates. Selected cultivars of

small, round types may be sown earlier or later than usual, under cover if necessary

Dust seeds with an appropriate insecticide against cabbage root maggot and flea beetle and repeat as needed. flea beetle is a particular threat in dry weather. Radishes may be grown for seed crops. Summer radishes produce small, hot, edible seedpods.

### SOWING RADISH SEEDS

	SMALL, ROUND	SMALL, LONG	LARGE, WINTER	ORGENTAL (DAIKON)	SEED CROPS
SIZE OF HADISH	lin (2 5cm) diameter	3m Bem long	Tlb (500g) of more in wright	2in (5cm) dameter B n (20cm) long	
When to sow	Spring to late	Spring to late	Summer	Mid- qo lige su oroci	Spring to late
SPACENG OF PLANTS	lin (2.5cm)	Itn (2.5cm	6in (15cm)	4o (10cm)	bin 15cm
SPACING OF ROWS	ðin (15cm)	6m - 15cm	12m (30cm)	12m (30cm)	12m (30cm)
SOWING BEPTH	8m (1cm)	Sin (Tem	n (2cm)	sin 2cm3	Sin (Lim)
Tame United	Main crop: 3-4 weeks Farly or late crops 6-8 weeks	3-4 weeks	10-12 weeks	7–8 weeks	8–10 weeks or when pods are crisp and green

### RHEUM RHUBARB

SEEDS in spring | Division from autumn to early spring |

The edible rhubarb (Rheum x hybridum syn R x cultorum) is a perennial. It does not thrive in high temperatures and needs soil enriched with well-rotted manure or compost and a period of winter cold to bring it out of dormancy. Seedlings vary so rhubarb is best increased by division. A few steins may be harvested in the first year from divisions or in the second year from seedlings.

Sow seeds in a seedbed (see p 283), Im (2 5cm) deep, 12in (30cm) apart Thin to bin (15cm) apart. In autumn or the following spring, transplant the best Sow also in early summer in warm areas

Divide crowns once they are 3-4 years old, preferably in late autumn Take pieces of the rootstock, or "sets," at least 4in (10cm) in diameter (see right)



DIVIDING RHUBARD

Lift or expose the cown Living a spade car through it carefully, cusawing there is at least one main had on each piece. Replant it is well managed soil. If (90cm) apart each way, but we may be the test so that he had is just above the surface. From a named the had, then make

### SOLANUM

EGGPLANT, POTATO



SEEDS in spring (eggplant) 11 Tubeas in spring (potato) 1

This genus includes both the eggplant (Solanum melongena) grown for its fruit, and the tuberous potato (S. tuberosum). Both require a deep, free-

draining, fertile soil

22 4 1-4

### EGGPLAN1

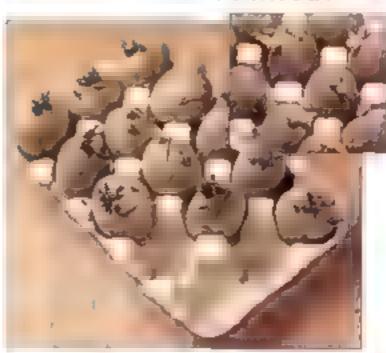
These tender perennials are grown as annuals in coid climates. They grow best in soil with medium nitrogen and in temperatures of 77-86°F (25-30°C) and 75 percent humidity, growth is checked below 68°F (20°C). For the best rate of germination, soak seeds in warm water for 24 hours. Sow thinly in trays or pots (see p 285) and transplant into 37/m (9cm) pots as soon as the seedlings are large enough to handle. Harden off it needed (see p 286) and plant out when 3-4m (8-10cm) tall In warm chimates plant in full sun 24-30m (60-75cm) apart each way, but protect from winds and low temperatures, which may stunt growth and cause bud drop

In cold climates, transplant into beds under cover at the same spacing as above or into Bin (20cm) pots of soil-based mix or grow bags. To save seeds, leave the fruits until ready to drop off the plant, then hang up until the color dulls, to allow the seeds to ripen. Slice in half, pick out the seeds, and dry

#### Ротато

These perennials are tender and grow best at 61–64°F (16–18°C). They need soil enriched with organic material.

### SPROUTING SEED POTATOES



to sprout seed potatoes, place in a box or tray in a single layer, "eyes" uppermost. Store in a light coul place until zin (2cm) green sprouts appear ausually six weeks). In a warm, dark place, the libers produce pale, weak sprouts (see inset)

### RORIPPA WATERCRESS

SEEDS in early autumn ‡ CUTTINOS in Spring ‡

Rooted cuttings of this annual (Rorippa mastartium-aquaticum, syn Nasturtium officinale) may be grown in water (see below) or in trays of gravel watered daily. Sow seeds on 2 in (5cm) of peat or capillary maiting (see right), keep moist at 64–70°F (18–21°C) until germination then circulate the water water daily with a pump or by hand. Harvest 4 in (10cm) stems in 8–14 weeks.

### SOWING WATERCRESS SEEDS



Stir progerminated seeds into fresh wallpaper paste. Fine a socid tray with moist capillary matting. Spread the paste. Cover with glass

#### TAKING WATERCRESS CUTTINGS



I from the stems of healthy plants satting just below a leaf joint. Tran off lower leaves from the bottom two thirds of each cutting. Place the cuttings in a iai filed with water. At ow to root in a bright place out of direct sunlight, as about 61% (16% for a week, ) so



2 When the cuttings have developed good root growth, drop them into a calm part of an unpollated running stream to grow on

### SCORZONERA

SEEOS (II Spring or in late summer !

Scozonera hispanica is a perennial tisually grown as an annual. It needs a deep, light, fertile soil with low nitrogen levels. It grows best in temperatures of around 61°F (16°C)

Use fresh seeds, because they do not store well. Plants flower in the second

veat and produce seeds in daisylike heads. Seeds need a soil temperature of at least 45°F (7°C) to germinate. Sow in spring in 8in (20cm) rows (see p 283) thin to 4in (10cm) apart. Harvest roots after at least four months, in autumn Alternatively, sow in late summer for a harvest in the following autumn.

#### PLANTING SEED POTATOES

	FIRST FARLY CROP
WHEN TO PLANT	Early spring
SPACING OF FUBLIS AND INVAS	12m (3ckm) in rows 18m (45cm) apart
TIME UNTIL HARVEST	100-110 days

early crops prefer medium nitrogen levels, main crops need high nitrogen Rotate crops (see p.282) to avoid buildup of soil-borne diseases, early crops are best rotated every three years and main crops every five years

Use only certified virus-free seed tubers, which are grown free of aphids to avoid the spread of viruses. If growing potatoes for seed tubers, be sure to protect them from aphids

SECOND EARLY CROP	MAIN CROP
Mudspring &	Late spring &
15th (38cm) in nows 27th (68cm) apart	25m (38cm) in rows 30m (75cm) apart
110-120 days	125-140 days

In colder regions with a shorter growing season, seed potatoes are often sprouted under cover (see facing page) to start them into growth before planting. The more sprouts there are on a tuber, the higher the yield will be. For large early potatoes, rub off all but three sprouts. Discard any that look unhealthy

If needed, cover earlies with fleece or plastic film (see p.39) to protect against light frosts. Plant main crop potatoes when the soil temperature is above 45°F (7°C) and all risk of frost is past. Potatoes may be intercropped (see p 285) with leafy brassicas or in a deep bed with peas or beans.

Seed tubers may be planted in various ways, in a trench, raised bed, or through black plastic to avoid the necessity to hill up the growing shoots (see below). If space is limited or conditions are unsuitable, early potatoes can also be grown in deep containers (see below) outdoors or in a warm greenhouse.

Problems that may affect the tubers include slugs, wireworms (see p 47) poiato cyst nematodes, blight, ring rot, common poiato seab, bacterial rot (destroy at once), internal rust spot and potato spraing. Many cultivars are available with varying degrees of resistance to disease.

### PLANTING SEED POTATOES IN A BED



IN A TRENCH Using a spade make a drill that in 3-tim (8-15cm) deep. Set the tubers in the dr it at the correct spacing (see chart, above) with the sprouts uppermost. Cover and mound up slightly. Begin hilling up around the new shoots when they are about but (15cm) tan



ON A DEEP DED Prepare a raised bed (see p 283) Lay the tubers on the soil 4in (10cm) apart, noting their positions. Cover them with 6-8in (15-20cm) of well round compost. Top with black plastic and weigh down. Make slits above each tuber for the shoots to grow through



UNDER BLACK PLASTIC Prepare a nursery bed and cover it with black plastic, anchoring it by burying the edges. Make cross-shaped cuts in the plastic 12m (30cm) apart each way. Plant a seed tuber through each slat, 4-5m (10-12cm) deep with its sprouted end uppermost.

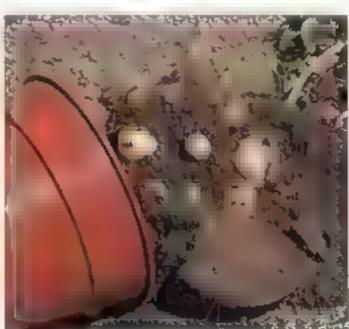
### PLANTING SEED POTATOES IN A CONTAINER



I fill a 12in (3bom) pot with sear based potting mix or soil to one-third of its depth, and mix in a small handful of general-purpose tertilizer. Place a sprouted tuber in the center with the sprouted end uppermost.



2 Cover the tuber with about 2m (5cm) more potting mix or soil, and grow on in a frost free greenhouse. When the new shoots are 6m (15cm) tall, begin to hill them up in stages half-burying the shoots each time



3 When the shoots have been hilled up to the rim of the pot, water and allow to grow in Knoch out the pot to harvest the potatoes when the flowers open or when the top folioge begins to die back

### SPINACIA SPINACH

SEEDS from late winter to midsammer I

Spinach (Spinacia oleracia) is an annual, leafy crop, growing best at 61-64°F (16–18°C). The seeds are difficult to germinate above 86°F (30°C). Sow them in drills (see p. 283) at three-week intervals, %in (2cm) deep and 2in (5cm) apart, with 12m (30cm) between rows. Thin seedlings to 6in (15cm) for large plants. Use specially bred cultivars for summer sowing to avoid boiling. Give high levels of nitrogen and water. Begin harvesting in 6–8 weeks. Sow seeds of bardier cultivars in early autumn for cutting in early spring.

### STACHYS CHINESE ARTICHOKE

TUBERS in late winter 11

The tuberous vegetable, Stachys affinis, is a perennial. The tubers need a long growing season of 5–7 months, so plant early in the season. Collect large, fresh tubers and divide as for ferusalem artichokes (see p. 302). Plant the tubers upright in light soil, about 3 in (8cm) deep and 12 in (30cm) apari

# TETRAGONIA NI W ZEALAND SPINACH

Seeds on min the spring 12

The seeds of this perennial (Tetragoma tetragomaides, syn. T expansa) have very hard coats, soak overnight before sowing. Sow seeds in drills 18in (45cm) apart (see p 283) after all risk of frost is past, thin to 18in (45cm) apart 5ow in midspring in warm climates or under cover in cells (see p 285) to plant out in late spring or early summer in warm climates, cuttings are possible

### TRAGOPOGON SALSIFY



Sals Is

SEEDS from early to sate spring I

Iragopogon porrejolius, also known as vegetable oyster plant, is a biennial grown as an annual root crop. The roots grow best in the same conditions and

sotl as scorzonera (see p 306). Raised beds are ideal. Always use fresh seeds viability quickly declines. Sow seeds in drills (see p.283). 12m (30cm) apart 4m (10cm) deep. Thin seedlings to 4m (10cm) apart. Roots mature in four months, they may be left longer in the soil until needed. Leave roots over winter for a spring crop of flower buds.

### VICIA BROAD OR FAVA BEAN



Broad Beans

SEEDS in automn, early spring, or late winter &

Broad beans (Vicia Jaba) are an annual crop growing best below 60°F (15°C) Some cultivars are quite hardy, tolerating 14.1 (-10°C) on free-

draining, well-manured soil Broad beans require low nitrogen levels and should be rotated every three years

Seeds germinate at low temperatures bow them in autumn or early spring (see below) in cold regions, sow seeds in containers (see p.285) under cover in late winter and transplant in spring. If needed, protect seedlings from (rost (see p.39) and mice and birds (see p.45)

Harvest beans from early sowings in 12–16 weeks and from winter sowings in 28–35 weeks. If saving seeds, grow the parent plants in a block and save seeds from plants in the center to reduce variability. Hang up to dry (see p 282) seeds stored in a cool, airtight place may last for up to ten years.



SOWING BROAD BEANS

Sow broad beans 4m (10cm) apart in tows 6m (15cm) apart. Make 2m (5cm) deep holes, and drop a bean into each. Cover with soil, water in and label.

### VIGNA MUNG BEANN BEAN SPROUTS

Seeds at any one 1

Presoak the seeds for 48 hours before sowing. They must be kept moist without being waterlogged, which leads to rot. One method is to sow them onto moist capillary matting, paper towels, or blotting paper as shown right. Keep the seeds at a temperature of 70°F (21°C). The sprouts should be ready to eat after 7-10 days. Alternatively, keep the beans in a jar (see far right) at the same temperature and soak two times a day by pouring water through the muslin, then draining off the water.

### ZEA CORN



ele es sa sp

SEEDS in spring 1

Corn (Zea mays) is an annual that needs fertile, free-draining soil with medium nitrogen levels. It is important to grow only one type to avoid cross-pollination, which impairs the

flavor, particularly of the supersweet types. Corn requires full sun and growing temperatures of 61–95°f (16–35°C) for 70–110 days to mature

Seeds germinate at 50°F (10°C)
Sow in an open site to assist pollination which is by the wind. Pollination is also improved by growing the plants in blocks, station-sow 2–3 seeds (see p. 284) at stations. 1-lin (35cm) apart. Thin the seedlings to one per station.



BOTTLE CLOCKES FOR CORS

In colder climates, protect carn seedlings with
bottle clockes. Cut the bottoms off the bondes
Place one over cuch seeding. Remove before
the plants reach the tops of the bottles.

### SOWING BEAN SPROUTS



Line a seed tray with damp paper towels. Sow thickly with presonked seeds. Cover with plastic wrap to keep moist. Ventilate occasionally In cold regions, sow seeds of early cultivars in a sheltered site. Another option is to sow singly in cells under cover (see p 285), but transplant the seedlings quickly, within two weeks, to avoid a check in growth.

Problems include corn rootworm European corn boter armyworm, cutworms, spotted cucumber beetle, asparagus beetles, and various smuts Raccoons may tear down the entire plant to obtain the ears

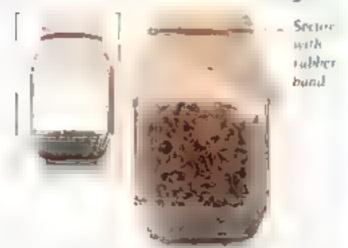
Corn may be grown as an intercrop (see p 285), for example with squashes as shown (below, left). For baby ears space early cultivars fin (15cm) apart. If saving the seeds of open-pollmated herrloom cultivars, grow an isolated block of at least 100 plants for seeds that are true to type.



CORN PLANTED IN A BLOCK

Many and female flowers are norne on the same plant. The male flowers produced in tassels at the top of the plant (see above) release pollen when the wind biows. The pollen adheres to the salky strands of the female flowers (see inset) ander which ears form. Sow corn in blocks to obtain a good rate of pollings in and crop

### SPROUTING BEANS IN A JAR



Souk beans in 1in (2 5cm) of cold water in a jar overnight (see inset). Seal with muslin, drain off the water. Leave in a warm, dark place. Rinse twice dody until sprouted.

#### OTHER VEGETABLES

AFRICAN OR INDIAN SPINACH AMARANTHEN CRUENTUS In colder areas, sow under coverm early summer or in cells at 72°F (22°C) and 70 percent humidity. Transplant 15-20in 38-50cm) apart protect until established In warmer clamates, sow in drills 12in (30cm) apart thin seedlings to 4-6in (10-15cm) # ARE GO LA, SALAD ROCKET ERUCA SATINA SON seeds in succession from late winter to early summer at +6-50°F (8-10°C), then from late summer to midautumn. In colder areas, protect early and late sowings under cover 1 ASPARAGES PEA LOTES TETRAGONORORES (SAN Terrations more size regreters). Seeds in mice to late spring at 50-59°F (10-15°C) in cells or 10m (25cm) apart in 15m (38cm) rows 44 CAPI GOOSEBERRY STRANBERRY TOWARD Physalis Peri Vasa. Sow seeds as for tomato. (see p 303): transplant under cover in colder climates to ensure ripe fruits \$\$ CIMON INDION OR YOU SPINACH BISTING u.n.). In warmer climates, sow seeds direct in spring at 77-86°F (25-36°C), 16-20m (40–50cm) apart. In colder chinates, sow. in travs or 2 in escint pots, transplant seedlings into 8in (20cm) pois, grow bag, or indoor bed 11

Chick PEA, Cicle Arithmat M. Sow three seeds at stations 10 in (25cm) apart in late spring at 50–59°F (10–15°C); do not thin. Sow under cover if needed \$44. Dry plants for seeds (see p. 282) before first frost. Chisast broccott Brassica raps yar. At 80GJ 48RA. Sow seeds cheef of in cells in late spring to early autumn as for broccoh (see p. 296), crops best from mids to late.

summer sowings &

CHOP SUPY CREENS CORSSANDRENG M. corrowant will how seeds thinly in rows 9in (23cm) apart at 50-59°F (10-15°C) from: carly spring to early summer. Bolts in heat. sow again in late summer to early autumn 1 CORN MEAN. LAMBS OF TUCH VALIDANIERA FOCUSTA. Sow seeds in cells in late spring at 30-59°F (10-15°C) or direct 15m (38cm) apart from mid- to late summer 4 DANDELION TARACTERS OF REINALE Sow seeds in spring at 50-59°F (10-15°C) in rows 14m (35cm) apart, thin to 2m (5cm) apart 1 EVENING PRIMROSE OF NOTHERABIEWSIS SOW seeds thinly as for parsnip (see p. 304) 44. GROUND CHERRY PHYSICIS PREINOSA. Sow seeds direct as for tomato (see p 303), but 4th (10cm) apart in rows 15m (38cm) apart 1 HAMBURG PARSLEY PETROSETPSI MICRISPEM VAR FLBEROSLAY Sow as for parsnip (see p 304) 1 HOT PEPPER CAPSKED FRUTESCENS SOW seeds

at 64–70°F (18–21°C)
from early to midspring,
transplant to 2ft (60°cm)
apart from late spring to
early summer ‡
[ICAMA PACHYRHIZE 5
TUBEROSE 5 Seeds in trays
in spring at 59°F (15°C)
transplant into pois; plant out in early

summer [1]. In warm areas, treat tubers as • r potatoes (p 307) ].

LAND CRESS BARBAREA VERNA. Sow seeds at

50-59°F (10-15°C) in nud- or late summer

for autumn to spring crops, sow from midspring to early summer for summer crop ttends to holt) Space rows 8in (20cm) apart thin to 6in (15cm) apart 1. M ZUNA GRUPUS BRASSRIA JUNCHA VAR JAPONICA Now seeds in cells in late spring at 59°F (15°C) or direct, space 4in (10cm) apart for small heads, 18m (45cm) apart for sarge heads. Good intercrop (see p 285) [ M. STARD OR THIS BRASSICA IL NOVA. Sow seeds. direct or in cells at 59°F (15°C) and to la c summer for autumn or winter crop, in early autumn under cover for late winter to spring crop. Thin to 12in (30cm) apart 1 PORTUGAL CABBAGE BRASSICA OF TRACEA TRONCHUDA GROUP. Sow in late spring at 50-59°E (10-15°C) 3-4 seeds at stations 2h (obcm) apari in rows 30m (75cm) aparc, that to one per statton 1 RAMPION CAMPANIA A RAPPING PLOS. Sow fine.

R Metos Campani da Rappse pitos Sow line seeds in early summer in sand along drills 9in (23cm) apari at 50–59°F (10–15°C), thin to 4in (10cm) apart 2.

Skirkt f Sich start at Sow seeds as for salsity (see p. 308) in early spring or early autumn. Lift and divide tubers in early spring, replant 12in (30cm) apart §

Sorret Remax selerates. Sow seeds in spring of automn at 50°F (10°C), in cells of in rows 12in (30cm) apart, thun to 10–12in (25–30cm) apart. Self sows readily 4. Sources Givens near Sow seeds in mid-to-late spring at 54°F (12°C). Bin (8cm) apart in double rows 15in (38cm) apart. Space double rows 30in (75cm) apart. Long term crop 44.

Session of RSLAND PORTUGACA OUTRACEA Sow at 50–54°F (10–12°C) thinly in 6in (15cm) rows in summer in colder areas, sow in trays, transplant into ceds, plant out after frosts I Texts Green's Brasica carryara. Sow direct at 50–59°F (10–15°C) every 2–3 weeks from early spring to early autumn, in rows 12in (30cm) apart thin to Im (2.5cm). For small waves, broadcast-sow in wide draft (p.283), do not thin. Sow under cloches if needed I Tomas tro Provacts raise saw Sow seeds as for tomatoes (p.303) II

William content Apply of Fisher on Seeds in

spring or late summer to rows 9in (23cm) apart at 50–50°F (10–15°C) thin to 8in (20cm) §. Divide every 3–4 years as for chives (see p.291) §. Winter pure and Montal PERFORMAL Sow in spring or

late summer and autumn at 50°F (10°C) in trays, broadcast or in 6–9in (15–23cm) rows I

ARLGULA

# GLOSSARY

The glossary explains horticultural terms that occur in this book, as applicable to plant propagation. Fuller definitions may be found throughout the text.

ACIDIC (of son) With a pH value below 7
ADVENTITIOUS BJD Latent or dormant
bud on the stem or root, often invisible
until stimulated into growth.

AERATION Opening up of soil/soil mix structure to allow free circulation of air ALKALINE (of soil) With a pH value above 7

ANGIOSPERM Flowering plant that bears ovules, later seeds, enclosed in ovaries (see also Gymnosperm)

APOMIXIS (adj. apomictic) Asexual production of tipe seeds. Offspring are clones, genetically identical to parent AUXIN Synthetic or naturally occurring substances in plants controlling shoot growth, root formation, and other physiological processes

AXILLARY BUD Bud borne in the angle between a leaf and a stem, between a main stem and a sideshoot, or between a stem and a bract

BISEXUAL (hermaphrodite) Refers to flower that bears male and female reproductive organs

BLEEDING The oozing of sap through a cut or wound

BREAK To produce new growth, often when a shoot emerges from a bud CALLUS Protective tissue formed by the cambium to aid healing around a wound, particularly in woody plants

CAMBIUM Layer of growth tissue capable of producing new cells to increase the girth and length of stems and roots

CAPPING A crust forming on the surface of soil or soil mix caused by heavy rain or watering or by compaction

CHITIN An extract from crustacean and insect exoskeletons, used in soil mixes CHLOROPHYLL Green pigment that enables plants to capture energy from sunlight and so manufacture food (see also Photosynthesis)

CHROMOSOME String of genes contained within a cell nucleus, responsible for transmitting hereditary characteristics. CLEISTOGAMIC Type of self-pollinating, often insignificant, flower that remains closed.

CLONE A genetically identical group of plants derived from one individual by vegetative propagation or apomicis COTYLEDON (Seed leaf). First leaf or pair of leaves produced by a seed, frequently different from the true leaves.

CROSS To interbreed (see also Hybrid)
CROWN 1 Upper part of rootstock from which shoots arise at or just below soil level 2 Branched part of tree above the

trunk. 3 Entire rootstock, as in asparagus and rhubarb

DICOTYLEDON Angiosperm with two seed leaves, net-veined leaves, often a cambium layer, and floral parts in fours or fives (see also Monocotyledon)

DIOECIOUS With male and female flowers on separate plants, both male and female plants are needed for fruits

DORMANCY (adj. dormant) Temporary cessation of growth, and slowing down of other functions, in plants in unfavorable conditions

DRILL Narrow, straight furrow in the soil in which seeds are sown EPICORMIC SHOOTS. Shoots that develop from latent or adventitious bads under the bark of a tree or shrub, usually close to pruning cuts or wounds.

ETIOLATED Describes a plant that has unusually elongated, often pale, shoots as a result of low light levels.

EXTENSION GROWTH New growth made

EXTENSION GROWTH New growth made during one season.

EYE 1 A dormant or latent growth bud that is visible at a node 2 The center of a flower

GREX Collective term applied to all the progeny of an artificial cross from known parents of different taxa. Mainly used for orchids and rhododendrons GYMNOSPERM Tree or shrub, usually evergreen, that bears naked seeds in cones rather than enclosed in ovaries, such as conifers (see also Angiosperm) HEAD BACK To cut back the main branches of a tree or shrub by at least one half of their length.

HYBRID The offspring of genetically

different parents, usually of distinct species (interspecific hybrid). F1 hybrids are uniform, vigorous offspring, resulting from crossing two genetically pure parents.

INFLORESCENCE A group of flowers borne on a single axis (stem) INTERGENERIC HYBRID Hybrid from two different, but usually closely related,

LATEX Milky white sap or fluid that bleeds from some plants when stem is cut or wounded, may be irritant. LINE OUT. To insert cuttings or to transplant seedlings or new plants in rows in a nursery bed.

MAIDEN A tree in its first year.

MERISTEM Tip of a shoot or root in which cells divide to produce leaf, flower, stem, or root tissue; may be used in micropropagation.

MONOCARPIC Refers to plants that flower and produce seeds once, then die MONOCOTYLEDON Angtosperm with a single seed leaf, parallel veined leaves, no cambium layer, and floral parts usually in threes (see also Dicotyledon)

MONOECIOUS With separate male and female flowers on the same plant MONOPODIAL With a stem or rhizome growing indefinitely from a terminal bud not usually forming sideshoots MOTHER PLANT See Parent plant. NODE Point on a stem or root, often swollen, from which shoots, leaves, leaf buds, or flowers arise PARENT PLANT Plant that provides seeds or vegetative material for propagation PETIOLE Leaf stalk, connecting the leaf to a stem or branch PH Measure of acidity or alkalimity. used for soils or soil mixes (see Acidic, Alkalme) Neutral soil has a pH of 7 PHLOEM Part of tissue within the stem. that transports nutrients around the plant (see also Vascular bundle) PHOTOSYNTHESIS Complex series of

PHOTOSYNTHESIS Complex series of chemical reactions in green plants and some bacteria, in which energy from sunlight is absorbed by chlorophyll and carbon dioxide and water are converted into sugars and oxygen

PITH (of stems) The soft plant tissue at the center of a stem

SAP Plant fluid contained in the cells and vascular bundle

SELF-FERTILE Refers to a plant that produces viable seeds when fermized with its own pollen

SELF-STERILE Refers to a plant that needs pollen from another individual of the species, but not a clone, to produce viable seeds

SPORT (mutation) Natural or induced genetic change, often evident as a flower or shoot of a different color from the parent plant

STIPULE Leafl ke or bractlike structure borne, usually in pairs, at the point where a petiole arises from a stem STOCK PLANT. A plant used to produce propagation material, whether seeds or vegetative materia.

Sympodial. Form of growth in which the terminal bud dies or ends in an inflorescence, and growth continues from the lateral buds.

TAXON (pl TAXA) A group of living organisms, applied to groups of plants that share distinct, defined characters TRANSPIRATION Evaporation of water from the leaves and stems of plants TURGID Refers to a plant when its cells are fully charged with water XYLEM Woody tissue in plants that transports water and supports the stem VASCULAR BUNDLE Conductive tissue, including the cambium, phloem, and xylem, that enables sap to pass around the plant

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